THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XIX. No. 466—22ND YEAR.] LONDON, AUGUST 16, 1870. [Subscription per Annum. { 15s. in Advance. 18s. Credit.] DOUBLE No. Price 1s.

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10,000 cubic feet of gas per ton of coal.
26-candle gas.
13¼ cwt. coke per ton of coal.
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PARIS EXHIBITION, 1867.
THE TESTING-HOUSE REPORTS.
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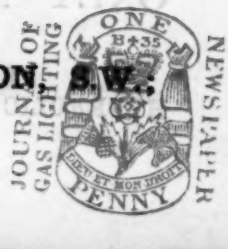

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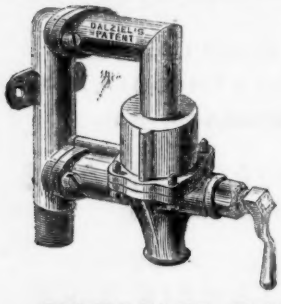

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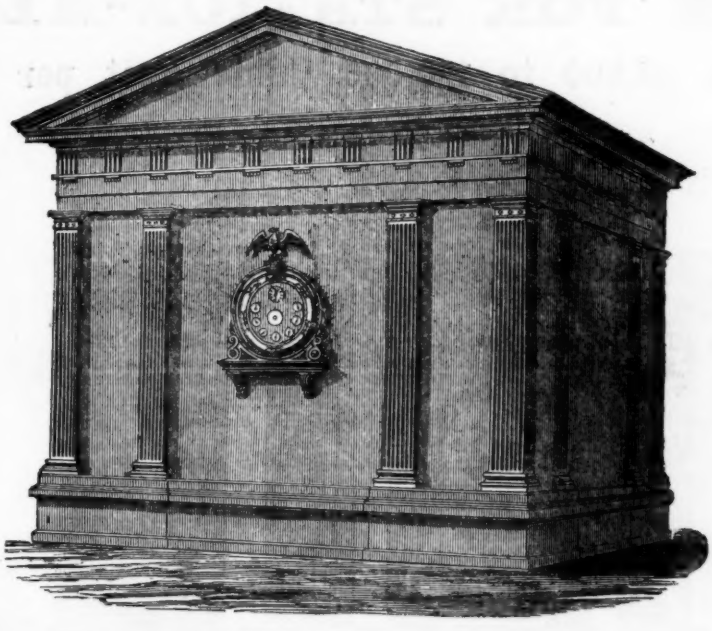

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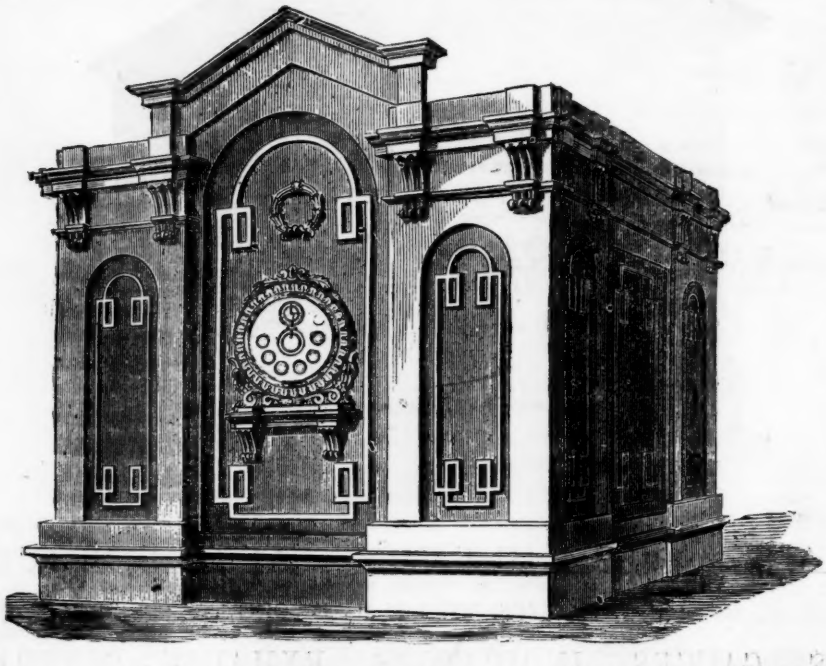

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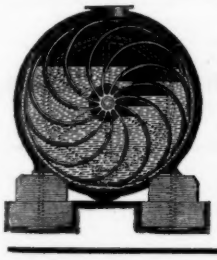

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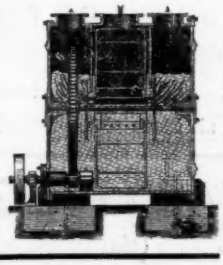

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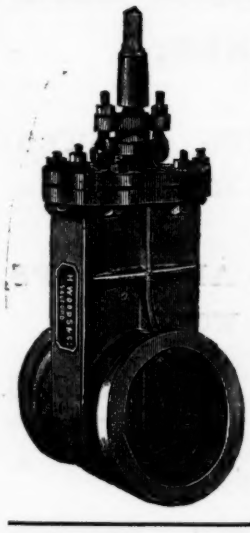

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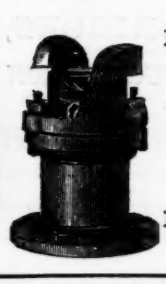

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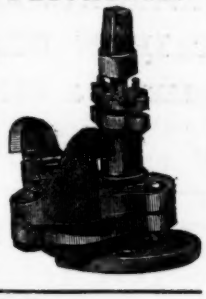

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(COPY.)

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Best Silkstone . .	10,900	17·0	12·8	2·6	1·7
Norfolk Silkstone . .	11,000	15·94	12·5	4·4	1·64
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NOTE.—The illuminating power of the Gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

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And BIRMINGHAM (TANGYE BROTHERS), CORNWALL WORKS, SOHO.

SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS.

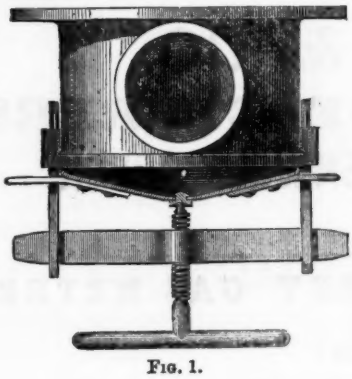

FIG. 1.

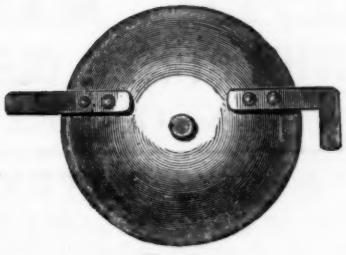

FIG. 2.

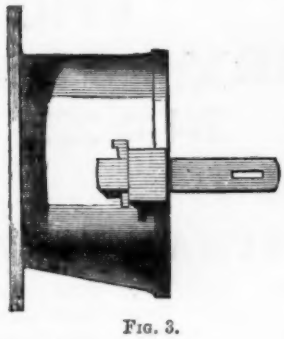

FIG. 3.

Several Hundreds in successful operation in various Gas-Works.

The expensive and cumbersome process of sealing the mouths of Gas-Retorts by means of luting the Lids with lime and other materials hitherto used for that purpose, is henceforth rendered unnecessary, and will be superseded by the very efficient method shown in the accompanying illustrations.

Fig. 1 shows a plan of a mouthpiece with Morton's Patent Lid in section. The mouthpiece is faced true, and the projecting circular edge or periphery of the lid is also turned true, and, by preference, of a semicircular section, so that the point of contact is reduced to a minimum; the convex form of the Lid rigidly sustains the force of the screw, which, by its central action, gives the Lid a uniform bearing, and effectually seals the mouth of the Retort.

Fig. 2 shows a front view of Morton's Patent Lid, which is stamped out of plate iron, having (in this case) ledges to rest on the lugs of the mouthpiece; these Lids, however, are more generally fitted to hinged cross-bars, by which means they remain suspended while the charge is withdrawn and the Retort charged, so that the damage done by throwing them about is entirely prevented.

The advantages obtained are—

1st. The sound sealing of the Retort during the whole time it is carbonizing the charge of coal, there being no jointing medium between the Lid and the mouthpiece.
2nd. The improved condition of the coke by the non-mixture of lime.
3rd. The Lid requires no preparation on the part of the stoker, beyond slightly scraping the surface to remove extraneous grit or dirt.
4th. The Lids are only about two-thirds the weight of the old form in general use, a Lid for a 16-inch mouthpiece weighing a little over 20 lbs.
5th. The Self-sealing Lid reduces labour, saves wear and tear, obviates all the inconvenience and discomfort consequent on the preparation of luting, and effects a great reduction in the working expenses. The cost attending the process of "luting" in several large gas-works, exceeds £1000 per annum, ranging in various works from 20s. to 35s. per mouthpiece.

It will be obvious that a round Lid is the most convenient and the cheapest form. D Retorts are adapted for round Lids, by carrying the bottoms down the necessary depth for that purpose, as shown in Fig 3. Some mouthpieces have been thus adapted, and are in use at the Chartered Gas-Works.

The following testimony speaks in favourable terms after ample and careful test:—

Burslem and Tunstall Gas Company, Longport, Staffordshire, Oct. 12, 1869.

Dear Sir,—In reply to your favour of the 9th inst., I have pleasure in stating that my admiration for your Patent Retort-Lid is most unqualified. I have 14 of them in use, and have tested them in the severest manner possible at these works, but without being able to detect the slightest defect. Yesterday the strap slipped off the exhauster, and a pressure of 13 inches was thus almost instantly thrown upon the Retorts, but although many of the luted Lids were leaking, not the slightest escape was observable from yours. I had anticipated that at least some greater degree of care would have been required in the scraping of the mouthpieces after the drawing of each charge, but even in this particular I find that labour has been reduced.

By every stoker on these works, as well as by myself, your Lids are regarded as a boon.

Please send me 30 more at your earliest convenience.

I am, &c., (Signed) HENRY WOODALL.

R. Morton, Esq.

Chartered Gas Company, Horseferry Road, Westminster, Sept. 15, 1869.

Dear Sir,—I have only lately returned to town, which is the reason I have not replied earlier to your inquiry.

I beg to say that I have had your Lids in use for upwards of two months, and during that time they have always kept a perfectly sound joint. I may add that where your lids are used only one set is required.

I remain, &c., (Signed) G. O. TREWBY.

R. Morton, Esq.

Chartered Gas Company, 146, *Goswell Street, E.C., Oct.* 20, 1869.

Dear Sir,—I have much pleasure in stating that, after some months trial of your Retort-Lids, I find them everything I could desire. I consider the plan a great improvement.

I am, dear sir, yours truly, (Signed) A. UPWARD.

R. Morton, Esq., London Gas Company.

These Lids are in successful use at the London Gas-Works, the Chartered Gas-Works, the Dublin Gas-Works, the Burslem and other Works, giving great satisfaction.

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London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

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THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

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PATENT WET & DRY METERS,

STATION-METERS AND GOVERNORS,

PRESSURE REGISTERS, GAUGES,

EXPERIMENTAL METERS, PHOTOMETERS, GASHOLDERS, &c., &c.

WATER METERS.

W. P. & Co. beg to state that they are now prepared to supply Station-Meters with planed joints.

CONTENTS.

	PAGE
Notes upon Passing Events:—	
Death of Sir John Thwaites	609
Mr. Reed and the Admiralty	609
Government Rewards to Inventors	609
The Metric System in British India	609
The Present Condition and Public Works of Canterbury, New Zealand	610
Report of the Metropolitan Police Commissioner	611
Circular to Gas Companies:—	
The Gas and Water Facilities Act	611
Report of the Gas Referees on the Sulphur Question	611
The Perth Corporation and the Gas Companies	612
The Local Board of Sheerness and the Gas Company	612
Purchase of the Leeds Gas-Works by the Corporation	612
Correspondence:—	
Davies's New Exhauster	612
Gas and Water Affairs in Oxford	612
Parliamentary Intelligence:—	
The Gas and Water Facilities Bill	613
Progress of Bills in House of Lords	614
Progress of Bills in House of Commons	614
House of Commons Committee—Blackburn Corporation Improvement Bill	615
Miscellaneous News:—	
Berlin Water-Works	619
First Report of the Gas Referees upon the Sulphur Question	619
Death of Sir John Thwaites	624
Termination of the Dispute at the Thorncliffe Collieries	624
Hard *v.* Soft Water	624
Register of New Patents:—	
Applications for Letters Patent	624
Grants of Provisional Protection	624
Notices to Proceed	624
Patents which have passed the Great Seal	624

TO CORRESPONDENTS.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—*Want of space compels us to defer till our next the publication of the report of the proceedings of the late meeting of the association.*

NOTICES.

The subscription to the JOURNAL is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders should be made payable at the Money-Order Office, London, to William B. King, 11, Bolt Court, Fleet Street, by whom the business department of the JOURNAL is conducted.

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THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 16, 1870.

Notes upon Passing Events.

THE death of Sir John Thwaites must be counted as one of the fortunate events of his life. After having conducted with marked success the business of the important office to which he was elected by almost an accident, he has died, after the completion of the main drainage and the opening of the Thames Embankment, without incurring the annoyance which a discussion on the subject of a pension would have involved, or enduring the mortification of seeing the Metropolitan Board superseded by a comprehensive municipal arrangement for the whole metropolis. Sir John Thwaites was a self-educated man, with little or no technical knowledge of any kind. He trained himself for the high office he so unexpectedly attained in parochial agitation and parochial offices. He owed his election chiefly to the number of his opponents, and to the combinations of a party whom, by his impartiality, he thoroughly disappointed. Tact, temper, and industrious business habits enabled the Dissenting shopkeeper, educated in a village school, to earn respect and confidence, while occupying a less ceremonious but more important position than that of any Lord Mayor of London. The choice of Sir John Thwaites's successor will impose a very difficult task on the Metropolitan Board. Will they select a lawyer, an engineer, or an architect, or will they dispense altogether with technical knowledge, and take some man of parliamentary influence and experience in presiding over committees? On the character of the next chairman the final fate of the Metropolitan Board will very much depend.

Mr. Reed has lost no time in justifying the opinion we have always expressed, that he was not the man to direct the Admiralty in its course of naval construction. He is of the same type as Colonel Boxer. He would accept no prescription for the benefit of the nation until it had been altered and stamped with his own name. It is far cheaper to pay such men liberally for what they can do, than to put them in a position of trust which enables them to disfigure or burke every rival's invention. Admiral Symonds and Captain Sherard Osborne may not be competent to design ships of war with scientific accuracy, but they know a great deal better than Mr. Reed what it is needful that a ship of war should be able "to do and to suffer." Mr. Reed's *animus*, as regards Captain Cowper Coles and his turret system, while in office at the Admiralty, may be gathered from his spiteful letter to the *Times*. Spiteful men and prejudiced men are out of place in official authority, however clever and ingenious. Mr. Reed has built some very good and some very bad ships as chief naval constructor, but he has also delayed for years the adoption of the form of war ship which, according to the evidence of "sailing and fighting "seamen," is infinitely superior to Mr. Reed's and Sir Spencer Robinson's pet broadsiders. Colonel Boxer has been very quiet since the publication of the correspondence on the causes of his dismissal. We shall not be surprised to find that in his retirement he has perfected a very superior *mitrailleuse*, which the Government may very properly purchase from him.

A parliamentary paper, "Copy of Reports and Correspondence "explanatory of Rewards to Inventors in the Army Estimates for "1870-1," shows how very fortunate it is for an inventor when he occupies an official position, and can try his experiments with Government labour and materials. In the first case, Mr. Goddard, of Birmingham, claimed £10,000 for his contributions toward constructing a breech-loading cannon, and he suggested that Sir William Armstrong had borrowed his invention. After long inquiries, and several refusals, he succeeded in getting £500. In the opinion of the most experienced artillery officers, neither Sir William Armstrong's nor the Prussian Krupps, nor any other breech-loading system for large guns, is either safe or sound, and in this opinion very eminent manufacturing mechanics agree. Mr. Parsons claimed a large sum for originating the system, known as Palliser's, for lining a cast-iron gun with wrought iron or steel tube. The question was referred to the arbitration of Mr. Hutton Gregory, who decided that there was a great similarity between the Palliser and Parsons plans, and finally Mr. Parsons was awarded £1000 instead of the £10,000 he asked, "in consideration of his having at an "early period directed the attention of Government to a method "of converting ordnance, the principle of which has been ulti-"mately adopted in the public service." We hear, however, on good authority, that the navy do not like these converted guns at all, and have not that confidence in them which the commander of a fighting ship ought to feel. We shall not be surprised to hear shortly that the Fraser service lined gun has been abandoned in favour of the homogeneous metal of Sir Joseph Whitworth. In this work Mr. Reed, as Sir Joseph's assistant, will be in his place. Commander Colomb, in conjunction with Major Bolton, is the author of a system of army signals by flashing, which has been adopted in both the army and navy. Major Bolton received his expenses, £1000, promotion, and an appointment as instructor of signalling. Unfortunately for Commander Colomb he has no friends at Court, and he is able to write very biting letters. In the end he was offered £500, provided he would accept it in full of all demands—the offer being couched in a very offensive tone. In reply, the commander writes from Bombay to the Under-Secretary at War: "Had nothing been added "to this (offer), or had you informed me that no further reward "would be granted, I should have accepted the honorarium with "pleasure, and without question. The conditions annexed to the "final paragraph appear to show that in accepting this £500 I shall "officially admit that I have received full money value to Govern-"ment for my invention of flashing signals. As I am not prepared "to make this admission, I most respectfully decline to receive "the reward." So the ingenious commander got nothing for one of the most valuable military inventions of the age. The last case is that of the family of the unfortunate Mr. Snider. Mr. Snider's rifle was adopted in 1865, and 500,000 muzzle-loaders were altered on his system. In 1866 he asked for £2700; in the meantime he had been sued by the War Department for value of gunpowder used in his experiments—a few pounds. Dying and harassed with debts, poor Snider accepted £1000 in full of all demands. On the recommendation of the Secretary of War, Mr. Cardwell, the balance of £1700 has been paid to Mr. Snider's family. Lord Northbrook, in writing to the Treasury, says: "There can be no question that the success of the converted arm "has exceeded the most sanguine expectations."

For a specimen of *doctrinaire* prejudices overruling the dictates of common sense, commend us to the correspondence on the subject of the application to India of the metric system of weights and measures. British India, it seems, is troubled with a puzzling diversity of weights and measures. The Governor-General in Council recommends, and the Secretary of State for India

approves, the introduction of the French metric system, with the kilogramme of 2·205 lbs. as a new unit, because it nearly approaches the "seer," an Indian weight of 2½ lbs. The objections to this proposal are admirably stated in a minute by Mr. H. I. Prinsep. It seems that many years ago the directors of the East India Company obtained a report which gave the various weights in use amongst their subjects. They found that the weights were usually based upon the coin of the locality. They, therefore, decided that the first step towards uniformity would be uniformity of currency, and therefore, in 1835, they established and began to issue the rupee, now universally current, of 180 grains. In this is the unit required, superior in every point of practical use to the arbitrary imposition of a unit entirely new, and in no respect Indian. Retaining this unit of the "tola" of 180 grains, "there is nothing better that we can adopt than the seer of 80 "tolas and the "maund" of 40 tolas, which exactly equals the "100 lbs. troy." Under "the new scheme, it is proposed that "the Government shall furnish the weights to every one that "wants them. . . Let any one consider how many villages "there are in India, and how many shopkeepers in each, all of "whom would require to be furnished with a new set. Are they "to be furnished gratis? Could the smaller shopkeepers pay for "them? At present, in many hundred shops that I visited, I "found the seer and half-seer weights to be boulder stones picked "up in the bed of a river—very good weights, if true, which any "one could test by weighing against tola rupees." "It is com-"puted," says a report, "that there are thirty million sets of "weights in use in the United Kingdom. Calculate from this "number the number that would be required by the population "of India, which is, at least, ten times as numerous as that of "England." These plain, common sense arguments did not prevail against the passion for scientific symmetry which influences the advisers of the Secretary of State for India; the Duke of Argyll has approved of the kilogramme unit. At home it is quite time that we abolished a custom—we cannot call it a system—of weights and measures which "no fellah can understand." A uniform system, whether decimal or binary, could be easily introduced in the three kingdoms, within a few years, by making instruction in it compulsory in every school, in every municipality, in every public office; but to undertake to re-educate the millions of peasant cultivators of India is indeed a utopian task.

The influence which the character of the inhabitants has on the progress of a country is illustrated in a very striking manner by the present condition of the colony of Canterbury, in New Zealand. Canterbury colony flourishes; it contains over 50,000 white inhabitants, and a great wealth in sheep and live stock, on a country which, twenty years ago, was almost uninhabited, and bare of useful quadrupeds. On public works, roads, railroads, &c., nearly two millions have been expended—a large portion of that sum unwisely, but still it has been raised and the work done. The colonists of Canterbury are above the average in social position and intelligence, and equal in energy to those of any other colony of the same character; yet it may be roundly stated that every single theory on which the colony was originally founded, except that of attracting a large number of educated gentlemen, has been utterly falsified. It was the last scheme of that arrant charlatan and eloquent writer, Edward Gibbon Wakefield. He found a number of bishops, noblemen, and gentlemen of High Church views to combine in founding a colony which was to be composed of churchmen, headed by a bishop, and to be concentrated on an agricultural district, divided amongst landlords, tenants, and labourers, as opposed to the despised sheep-feeding, squatting system, on which the Australian colonies had flourished and grown important as the greatest wool-producers in the world. This was before the days of gold diggings. The concentrated settlers were to pay a much higher price for their land than in any other Australian or American colony; but, in return, the landowners were to have an ample supply of labour-roads from their farms to a port, with churches and schools in the centre of at least every square mile. On these promises, many shiploads of the best class of colonists went out and invested their money. Lady Barker's very fresh and graphic book of letters from Canterbury, published the other day, shows incidentally, and without the slightest reference to colonizing theories, how completely all these fine schemes have been falsified by irresistible circumstances. Sheep-farming is the only profitable business in Canterbury for men of capital, and these farmers are spread over a country as big as Ireland, on vast treeless plains divided by river-beds, which are usually dry, but are suddenly filled with roaring torrents on the melting of the mountain snows. Agriculture by hired labour does not exist—it would not pay; and, in spite of Protectionist prices, the frugal labourers rapidly became small landholders, or, in the contemptuous terms of the squatters, "cockatoo settlers." As for the churches and schools, which formed so tempting a part of the original prospectus, they are only to be found in a few favoured districts close to the coast. The first settlers found themselves disembarked on a narrow slip of land, forming Port Lyttleton, divided from the plains fit for cultivation by an Alpine hill, which only practised mountain-climbers could cross; while the only other access to the plains where they had purchased farms was by a dangerous bar-river, the Heathcote. No one has ever ventured to calculate how many tens of thousands of pounds were lost in goods and implements shipwrecked on the river, or abandoned on Port Lyttleton for want of means of transport. But the enthusiastic founders of the settlement, many of them connected with wealthy families, were ashamed to admit a failure, and, so to speak, stuck to the ship, and at an incalculable cost made a wool-growing pastoral success out of the feudal High Church colony of their dreams. Never was more money obtained for worthless land, by high-sounding names, under false pretences.

Last year Mr. Edward Dobson read before the Institution of Civil Engineers a memoir on the public works of the province of Canterbury, which gives a high idea of the energy of the colonists, and a melancholy picture of the waste of capital caused by the ambitious plans of Lord Lyttleton and his fellow-dupes in the schemes of Gibbon Wakefield. The Government, amongst other works, made a road from Port Lyttleton to the nominal capital, Christchurch, "scarped out of the cliffs for a continuous "length of several miles;" a tunnel, nearly three thousand yards in length, "driven through the crater wall of an extinct "volcano, under a summit level of 1200 feet above the sea." Also a railway thirty miles long, and, according to the ambitious ideas of Canterbury colonists, on a 5 feet 3 inches instead of a 3 or 4 feet gauge. One of the engineers who took part in the conversation on the paper observed that the tunnel, owing to the large cost of construction, appeared to have exhausted the resources of the colony for further works. Communication across the beds of the torrents, which at times of the year form dangerous and often impassable rivers, are urgently required. But it is found almost impossible to obtain secure foundations for bridge-piers, and, besides, the direction of the beds of the rivers is continually changed. In the course of the discussion, the most feasible suggestion seemed to be tunnels under the torrent bed, which might more easily be constructed during the long periods when the channels are perfectly dry. A costly tunnel from Port Lyttleton to the plains was evidently as great a mistake as the broad-gauge railway, or, indeed, the choice of Port Lyttleton at all. The political difficulties of executing public works in such a colony are well described in the following passage, which, if anything, proves that the best Government for a few years would have been an engineer officer, with an advising, not legislating council. Since the public works of Canterbury passed into the hands of the local governments—vestries in fact—nothing has been done.

> It was necessary at an early date to decide upon the main lines of communication, in order that isolated works, executed without any apparent connexion, might ultimately (as the temporary circuitous tracks became closed up by fencing) form portions of a connected whole; and to accomplish this the Government had to incur an outlay which might appear unnecessary, but which in reality saved a heavier expenditure than would otherwise have been requisite.
>
> It was essential every year to open up fresh land for settlement, as upon this chiefly depended the progress of the land sales, and at the same time to satisfy the claims of those who had settled on their land, and who were clamouring for metalled roads on which to take their produce to market.
>
> It was requisite to provide employment for emigrants when work was scarce, but at the same time not to abstract labour from the ordinary work of the country; to avoid raising wages by employing labour at shearing time, ploughing time, haying time, or harvest time, and yet not to lay the Government open to the charge of wasting labour, or of doing work badly, because it had to be done in the wet season, when the public works department had few or no competitors as employers of labour. Again, if work was done by contract, the farmers neglected their proper business to engage in metalling contracts. If, on the other hand, work was done by day labour, complaints were constantly made of waste and inefficiency, and of the inability of the settlers to compete with the Government as employers of labour. Lastly—and this was the greatest difficulty of all—the works could only be put in hand by driblets, often at long intervals, and to such an extent only as might be warranted by the progress of the land sales, and as might be authorized by the Provincial Council, whose views, as might be expected, were generally swayed by local wants and local interests, the council of one year often ignoring the work of the previous one, and allowing important works to remain practically useless for the want of some connecting link, the value of which was not apparent to the authorities. These difficulties were further intensified by the physical character of the country. The agricultural land is situated principally in the swampy tract on the seaboard; the pastoral, on the higher portions of the plains and in the back ranges. The farmers, therefore, wanted the money to be spent in bridging creeks and metalling the swampy roads near the coast. The sheep-owners desired side cuttings to be made in the hills, and approaches to the ford in the gullies, in order to get their wool-drays to their stations. The farmers took their grain to market after harvest, when the unmetalled roads were soft with rains and frost, and often impassable. The sheep-owners carted their wool down to the port, and took back their station-stores in the heat of summer, immediately after shearing, when every mud-hole was baked to the hardness of brick, and did not, therefore, require metalled roads, which would only lame their bullock teams. Moreover, as, under the pasturage regulations, the stock-owners leases were subject to be determined at any time by the purchase of the freehold from the Crown, it was not the interest of the non-holders to give any facilities for settlement in their respective districts; and so long as the drays could get down the wool for shipment, and return with the regular supply of station stores, they were perfectly satisfied, as the worse the roads, the less chance of the choice portions of the runs being brought up for settlement.

One engineering difficulty was of an entirely new kind. The

watercress having been introduced into creeks near Christchurch, spread with such rapidity as to threaten their very existence, many streams being filled with a solid mass of vegetation, on which cattle could walk, and which had to be cut in bundles, like hay from a rick; £3000 was spent on the river Avon alone to abate this nuisance. After some years the vigour of the plant seemed to have declined, and it is now kept under without difficulty.

In the report of the Commissioner of Police of the Metropolis, from which we have already made extracts, the following recommendation on education might wisely be applied to the army under the new system of short enlistments:—

An educational test is prescribed for all men on promotion from the ranks to the post of sergeant, and on subsequent promotion to the rank of inspector or superintendent.

The examinations are now conducted by the Civil Service Commissioners, and they are of a nature to require considerable preparation on the part of the police.

Independent of the question of promotion, it is of great importance that every policeman should have a fair amount of ordinary education, in which many of them on joining the force are very deficient.

But while this is the case, no means are provided for their receiving any education beyond that classes for school are formed in each division, and efforts made to induce the men to attend them; but they have to pay their instructors out of their own pockets.

The weekly amount paid by each man varies from one halfpenny to sixpence.

I propose that every man, until he has obtained a certain amount of proficiency in reading, writing, and arithmetic, should be compelled to attend school at such times as may be directed, and that the cost of such instruction be defrayed from the police funds.

I propose to appoint a schoolmaster or schoolmaster-sergeant to each division for this purpose, to act, when not employed in instruction, as assistant divisional clerk.

If compulsory education were introduced into the army, discharged soldiers would be open to many more employments than they are now. It is distressing to meet men with the full number of good-conduct badges who, discharged with a full pension, are only fit for labourers employment because they "are no scholars." One of the appendices to this report gives the following biographical sketches of professional beggars, by detective officers specially employed for the purpose. They are well worth the study of those who wish to put down mendicancy:—

Reuben Aldred.—This man, dressed in the uniform of a light infantry regiment, states that he is 37 years old, that he is a native of the West of England, and that he formerly served in the Bengal Light Infantry (54th Regiment), but that he left the army when the East India Company's service was amalgamated with Her Majesty's army. When I met him on Monday afternoon he was begging at the corner of Vere Street, Oxford Street. I saw him relieved by a great many passers. He stayed there till dusk, and then proceeded down Oxford Street, begging in front of the bars of the different public-houses. He purchased what appeared to be "cuttings" at a cook-shop, and bread at a baker's. He then made his way to Monmouth Court, Seven Dials, where he went into a house. I waited for a long time, but did not see any more of him. I should think he must have received at least 1s. 6d. during the time that I had him under observation. He could tell a very good tale of soldiering in India, and this seemed to elicit charity, more especially at public-house bars. I also saw him on Wednesday afternoon, begging near the "Princess's Theatre." Upon this occasion he appeared to be frequently relieved. I have made inquiries, and find that he has no fixed home, and that when favoured by circumstances he generally passes the evening getting drunk. He is mostly begging about Oxford Street, Regent Street, or Regent Circus.

Mary Berkley.—This woman I have seen every day during the week with one or two children, under the piazza of Saint George's Chapel, Regent Street (a favourite rendezvous for beggars). She stated that she was a widow, and that she was living at 16, Drummond Street, Camden Town. When I accosted her I told her that I should send a lady to her who would probably relieve her. She then began to prevaricate with respect to her address, so that I was certain that she had given me a wrong one. During the time that I was questioning her she appeared very much inclined to be abusive. Not a carriage stopped without her begging of the lady or gentleman in it, and on many occasions she was very troublesome. I watched her leave Regent Street, in the evening, with another woman whom I meet daily near the piazza, begging. They must have been frequently relieved, as they drank at several places upon their way from Regent Street to Short's Gardens, where I found they lived. I have no doubt that they are both very dissipated, and by no means worthy of the charity which they receive.

John Prior (a blind man) states that he is 40 years of age; that he has been blind for about four years, his blindness being caused by working in the chalk quarries of Portsdown, Portsmouth. This man was seen by me several times during the week begging in Regent Street, Oxford Street, and the Haymarket. I called at the address which he gave me, 27, Eagle Street, Holborn, on Tuesday evening. The house is a "common lodging-house," and I found him seated in the kitchen before a substantial supper. There were several professional beggars in the same room; they all seemed very comfortable, and the majority were smoking and drinking. I found that this man generally spends his evenings there, and that he, as well as the other lodgers, is frequently drunk.

Alfred Ellaway.—This man is another of the daily mendicants of Regent Street and the neighbourhood. He is 38 years of age, and has been a cripple from birth. He wheels himself along the footway upon a truck. I called at the address he gave me, 7, Union Place, Castle Lane, Westminster, on Monday last, and found that he is the only support of an aged mother. The place they occupy was exceedingly clean for the neighbourhood. I do not think that this man or his mother are by any means unworthy objects of the charity he receives.

John Sullivan (a blind man) is a very old professional beggar, more especially in the neighbourhoods of Oxford Street and Charing Cross. He states that he is 38 years of age, that ten years ago he served in the 67th Regiment, but that he left that service for a civil appointment in the West Indies, and while there lost his sight. On Friday I called at his address, 14, Norfolk Street, Borough. I found that he, his wife, and two children, are all supported by the proceeds of his begging; that he and his family are well conducted, and that he generally begs till very late in the evening.

Mary Crawley (the blind woman alluded to in the commissioner's memorandum).—This woman has been begging in the neighbourhood of Charing Cross for very many years. She states that she is 60 years of age; that she lost her sight from small-pox. She is very troublesome, importunate, and not unfrequently abusive. I called at the address she gave, 5, King's Head Court, on Friday last. I found that she had been drinking too freely to answer any questions. She is a very dissipated woman, her evenings being generally spent in drinking with the people in the court.

Circular to Gas Companies.

The Gas and Water Facilities Act has received the Royal Assent. In its later stages Lord Redesdale succeeded in making an addition which considerably extends the operation of the Act. The Government appeared anxious to restrict the granting of powers for the amalgamation of undertakings to companies and persons "*duly authorized*"—that is, we presume, to those who had previously obtained provisional orders, or were empowered by Act of Parliament. But by the addition referred to the Board of Trade is enabled to grant orders authorizing two or more companies or persons *supplying* gas or water in any district or adjoining districts to enter into agreements and amalgamate their undertakings. This may be said to complete the Act, and extend it, as we remarked in our last, to meet every case in which parliamentary powers are required for gas and water undertakings. The Act, which we print in another place, gives full and precise instructions as to the proceedings by which provisional orders are to be obtained. The final stage, it will be seen, must be completed by the 23rd of December of any year. The Board of Trade will then give notice of the application, and appoint a day for receiving objections, and after considering these, will determine whether or not the undertakers may proceed with the application. Power is reserved to the Board to introduce such modifications and restrictions into the scheme as they may deem advisable; and every provisional order will contain such other provisions as, according to the nature of the application, and the facts and circumstances of each case, the Board of Trade may think fit to submit to Parliament for confirmation. There can be little doubt that in all gas schemes the Board will insist on some standard of illuminating power and purity, as well as some restrictions as to price; and these are matters which should be well considered before application is made for an order. Every order will contain the customary general restrictions relating to the erection of works and stores, and the acquisition of land. When obtained, an order will have no force until confirmed by Act of Parliament; and before a Bill can be introduced, the undertakers must deposit and publish the order as prescribed by Part IV. of Schedule B. Such publication must be completed before the 23rd of April of any year. The Board of Trade have thus about three months for the consideration of the applications and the objections thereto—a period short enough in any case, but especially so if the applications be numerous, and many objections be lodged. As we have said before, we have no knowledge of the machinery the Board intends to employ in the necessary inquiries. It is no light matter to assume the functions of a committee of a House of Parliament, and we may express a hope that the new tribunal may prove as competent and impartial as the one it supersedes. The Act very properly contains an important safeguard against prejudice and incompetence. A Bill to confirm any provisional order may be petitioned against and referred to a select committee, before whom the petitioners may appear and oppose, as in the case of a Bill for a special Act. This is a very important proviso, which may have the effect of preventing some of the abuses to which it appears to us the Act is liable.

The gas referees have published a "First Report" upon the sulphur question, which will be found *in extenso* in another place. The report is somewhat lengthy, and it is impossible here to give a full criticism of its contents. Starting with the assertion that they have examined the various methods hitherto proposed, as well as those at present in use, for purifying gas from sulphur, and after a remarkable account of the composition of illuminating gas, they proceed to state that every mode of purification which consists in passing the gas through various substances as through a sieve, abstracts floating particles of hydrocarbons, and therefore reduces illuminating power. This is a statement which can only be received with many qualifications. When gas is properly condensed the purifiers take out no hydrocarbons which it is advisable to retain. They next make the not very original remark that the efficacy of the purifying material is mainly dependent upon the length of time the gas is in contact with it, and instance the fact that in summer, when only half the quantity of gas which passes in winter is sent through the same extent of purifying surface, the amount of sulphur in the gas is practically the same. Here they appear to have overlooked the fact that the purifying materials are not so frequently changed in summer as in winter.

As regards the form in which the great bulk of sulphur exists in what we may call purified gas, we did not suppose there could be two opinions. It is quite likely that there may be sulphuretted hydrocarbons, but no chemist of any repute has ever expressed a doubt that the chief sulphur-holding ingredient is not bisulphide of carbon. The formation of this body in the manufacture of gas is easily accounted for, and the changes which take place in processes which certainly remove all sulphur from gas point to the fact that the sulphur compound is bisulphide of carbon; and

it is also asserted, with how much truth we cannot at this moment say, that the bisulphide may easily be isolated from the gas.

The most remarkable part of the report is that which relates to the efficacy of the various stages of purification in the elimination of sulphur. The conclusion to which the referees have come is that gas when it leaves the purifiers contains more sulphur than when it enters them. This is so manifestly absurd that we need say nothing about it. The statement that gas, after passing through oxide of iron, contained 37 per cent. more sulphur than before, carries its own refutation. Sulphuretted hydrogen, if the oxide was good for anything, must at all events have been taken out; and if it is pretended that the sulphur came out in some other form, still, according to common notions, it is impossible that more sulphur could have emerged from than entered the purifiers in any form whatever. The experiments on this point are evidently worthless. There is, we are inclined to believe, a gross error somewhere. We are not told by what means the amount of sulphur was determined in the experiments, and we decline to accept as conclusive, on such an important point as this, any results but those obtained by known perfect processes for the *exact* determination of sulphur, such as combustion in oxygen, or Mr. Valentin's method.

We may pass over the ideas of the referees as to the possible production of sulphuretted hydrogen in the gasholders on a hot day, and go on to the amount of sulphur impurity in gas. The practical fact shown in the tables given by the referees is that the gas of the Great Central Company contains less sulphur than any other, and they ascribe this to the use of lime. Lime, however, we believe is not used alone in the Great Central works; and a larger acquaintance with London works might have taught the referees that even lime alone may be used to as little advantage as oxide of iron. M. Ellissen several years ago pointed out that Dr. Letheby's apparatus failed to detect the whole of the sulphur in gas, and the fact has since been well known to instructed gas engineers. We have no assurance that the "new sulphur test" is not just as faulty as the old. The sole advantage the former possesses is that the products of combustion are prevented from escaping from the large end of the trumpet-tube; and it is very easy to alter the old Letheby apparatus so as to effect the same object. We have only to turn up the edges of the trumpet-tube, so as to form a cone over the Leslie burner, or, more simply, to put a perforated plate beneath, so as to prevent any air from passing, except through the centre of the burner, and results may be obtained even higher than by the new apparatus.

The difficulty the referees have in fixing a maximum for sulphur impurity is, no doubt, great, and is likely, we fear, to remain so for years to come. In the meantime, any light that they can throw upon the processes of purification will be cheerfully received.

The history of gas enterprise in the "fair city of Perth" is highly interesting and instructive. In 1823 the first gas-works north of the Forth were established in that city. The gas was then charged 15s.—a price which was gradually reduced until, in 1845, it stood at 8s. per 1000. In that year the Town Council encouraged the formation of a consumers company, who promised to reduce the price to 5s. Then began the usual ruinous competition, which ended in a working agreement between the two companies, and a rise of price to 7s. 6d. Soon after, Mr. Flintoff appeared in the city with his customary success. A second consumers company was formed under the patronage of the Town Council. They never erected works, but soon amalgamated with the new gas company; and another period of ruinous competition set in, during which the new company lost all their capital. Then came another working agreement between the old and the new company, which subsists at the present time. Having stimulated opposition in every possible way, the Town Council now step in and propose to buy the two existing companies, or to start another new company. They are encouraged, of course, by the success which has attended the purchase by the Corporations of the gas-works of Glasgow and Dundee—a success which naturally sets the local authorities of other large towns in Scotland upon attempting similar measures. At the present moment the companies decline to enter upon negotiations with the Council, who, it may be expected, will go to Parliament next session, although they express an anxiety to avoid a contest if possible. The Perth companies are under no restrictions as to price, quality, or purity, but they promise, if let alone, soon to reduce the price to 4s. 6d., or even lower, and pledge themselves that the illuminating power shall never be less than in any other town in Scotland. If these promises be fairly carried out, we do not see that the citizens of Perth can gain much by the transference of the gas-works to the Corporation. In any case competing works could only prove ruinous.

The Sheerness Local Board, in answer to their advertisement, have received two plans and estimates for the erection of gas-works, and have appointed a committee to decide which they shall accept. No definite step has, therefore, yet been taken towards the erection of the works, and it may be that the Board will even now recoil from taking any step. But with such a Board as Sheerness is honoured with, it is impossible to say what may or may not happen. Such a scene as that which took place at a recent meeting of the Board could hardly be paralleled at any Board or vestry in the kingdom. A resolution was passed by them on Friday last, excluding the public from future meetings of the Board—a measure that is naturally very unpopular.

It is announced that the Leeds Corporation, having raised the funds necessary to pay for the gas-works, have intimated to the gas companies that they purpose entering into possession of their works, under the Act of last session, on the 1st proximo.

With this number our subscribers will receive a supplementary sheet, containing the eighth of the series of drawings of the Beckton Gas-Works.

Correspondence.

DAVIES'S NEW EXHAUSTER.

SIR,—I wish to call your attention to a mistake made in the report, in your last JOURNAL, of the proceedings of the British Association of Gas Managers, in the statement that the "secretary read a paper by Mr. E. White, of Birmingham, on Davies's New Exhauster."

I had nothing to do with the paper further than introducing the writer of it (Mr. Davies), and obtaining the sanction of the committee to its being read. I pointed out to the committee and secretary the error that had been made in the printed programme of the meeting; and it was arranged that the president, in giving the list of the papers to be read, should correct the error by stating (as he did) "the last paper on my list is by Mr. Davies, introduced by Mr. E. White, of Birmingham, 'On a New Form of Exhauster.'" It was also arranged that the correction should be made in the printed report of the meeting. I am, therefore, surprised to find the original error repeated in the JOURNAL'S report of the proceedings, and shall feel obliged by your inserting this explanation in your next issue.

Birmingham Gaslight and Coke Company,
Windsor Street Station, Aug. 6, 1870. E. WHITE.

GAS AND WATER AFFAIRS IN OXFORD.

SIR,—Referring to the notice of the Oxford Gas and Water Works contained in the JOURNAL of the 2nd inst., I have to request, as a matter of common justice, that you will insert the following answers to the statements there made. It will be convenient to put the statements and answers in juxtaposition, as follows:—

At a fire in Oxford, two lives were sacrificed and the Bodleian Library was in danger.	This fire was in St. Aldate's Street, a quarter of a mile from the Library. The two houses burnt were timber built, and it is admitted that, had the engines, water, and fire-escape been on the spot as quickly as they are usually in London, neither the lives nor the houses could have been saved; the houses were mere match-boxes.
All the administrative power of Oxford is vested in a man who is reduced, if not to mental impotence, to utter incompetence, by old age. He is nearly eighty years old and stone blind.	The person alluded to is Charles James Sadler, who is father of the City and Council of Oxford, has been four times Mayor of Oxford, and has devoted all his life to the service of his native city. His age and blindness are facts. No administrative power is vested in him.
He is chairman of the Corporation Water-Works and Gas Committee.	He is not and never was chairman of either, and he never took any part in the management of the water-works, and has no more to do with them than as one of the 40 members of the City Council. The water-works are managed by five trustees appointed by the Treasury to act independently of the City Council.
	He has been the paid agent of the gas company for many years, and since the passing of the new Act, a year back, their concerns have been managed by the directors, who order everything, and direct and assist their agent in his duties out of consideration for his past services.
He will not resign, even for a pension, the salary of £300 a year attached to his office, and the patronage.	He has not been asked to resign, but he has offered to resign without making any terms. Nothing has been said about a pension, for the simple reason that the company have no power to grant one. He has no patronage.
Oxford gas in very impure.	Its purity is probably on a par with that of the Chartered Gas-Works, and, like that company, the Oxford Company are doing all they can to attain absolute purity by new purifiers, which are in course of erection.

For fifty years the ammoniacal refuse has been discharged into the soil, and has filtered away through the porous earth, until all the neighbourhood has been polluted; and it is only wonderful it has not reached the gathering-ground of the water-works.

It is true that we have not hitherto utilized our ammoniacal liquor, but part of our new contract is to erect the best modern scrubbers; the soil is not porous, in proof of which and of non-pollution, I, with three other persons, have to-day drunk of the water from a pump close to one of the gasholders, and I state positively that to the taste it is excellent spring water, equal in quality to what I drink at my house, supplied by a gutta-percha pipe from the virgin gravel stratum of St. Giles's Field.

I am secretary to the gas company, but not acting, as to this matter, for them or for the Water-Works Trustees. I write as Mr. Sadler's solicitor. The article has caused him intense pain both of body and mind, and he is desirous that another number of the JOURNAL OF GAS LIGHTING should not appear without a contradiction of the misstatements in the last.

Town-Clerk's Office, Oxford, G. P. HESTER.
Aug. 10, 1870.

[We regret that the paragraph referred to in the above communication should have appeared in our columns in the absence of the editor, and without his knowledge, and more especially for the pain it has caused to an old and esteemed friend, to whom we are indebted for many acts of kindness, and whose years and probity entitle him to our respect.—ED. J. G. L.]

Parliamentary Intelligence.

GAS AND WATER FACILITIES ACT.

AN ACT to facilitate in certain cases the Obtaining of Powers for the Construction of Gas and Water Works, and for the Supply of Gas and Water.

BE it enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

PRELIMINARY.

Short Title.

1. This Act may be cited for all purposes as "The Gas and Water Works Facilities Act, 1870."

Interpretation of Terms.

2. For the purposes of this Act the terms hereinafter mentioned shall have the meanings hereinafter assigned to them; that is to say:—

The term "local authority" shall mean the bodies of persons named in the table in the Schedule (A) to this Act annexed.

The term "road" shall mean any carriage-way being a public highway, and any bridge forming part of the same.

The term "road authority" shall mean any local authority, board, town council, body corporate, commissioners, trustees, vestry, or other body or persons in whom a road as defined by this Act is vested, or who have the power to maintain or repair such road.

The term "district," in relation to a local authority, shall mean the area within the jurisdiction of such local authority.

The term "The Lands Clauses Acts" means, so far as the provisional order in which that term is used relates to England or Ireland, the Lands Clauses Consolidation Act, 1845; and, so far as the same relates to Scotland, the Lands Clauses Consolidation (Scotland) Act, 1845; together with, in each case, the Lands Clauses Consolidation Acts Amendment Act, 1860.

DESCRIPTION OF CASES WITHIN THIS ACT.

Act to Apply to Certain Cases.

3. This Act shall apply where powers are required for all or any of the purposes following:—

(1.) To construct or to maintain and continue gas-works and works connected therewith, or to manufacture and supply gas in any district within which there is not an existing company, corporation, body of commissioners, or person empowered by Act of Parliament to construct such works or to manufacture and supply gas;

(2.) To construct or to maintain and continue water-works and works connected therewith, or to supply water in any district within which there is not an existing company, corporation, body of commissioners, or person empowered by Act of Parliament to construct such works and to supply water;

(3.) To raise additional capital necessary for any of the purposes aforesaid.

(4.) To enable two or more companies or persons duly authorized to supply gas or water in any district, or in adjoining districts, to enter into agreements jointly to furnish such supply, or to amalgamate their undertakings;

(5.) To authorize two or more companies or persons supplying gas or water in any district, or in adjoining districts, to manufacture and supply gas or to supply water, and to enter into agreements jointly to furnish such supply and to amalgamate their undertakings, and such purposes, or any one or more of them, as the case may be, shall, for the purposes of this Act, be deemed to be included in the term "gas undertaking" or "water undertaking," according as the same relate to the supply of gas or water: Provided that any gas or water company empowered as aforesaid may apply for and avail themselves of the facilities of this Act within their own districts respectively.

PROVISIONAL ORDERS AUTHORIZING GAS AND WATER UNDERTAKINGS.

By whom Provisional Orders authorizing Undertakings may be Obtained.

4. Provisional orders authorizing any gas undertaking or water undertaking under the authority of this Act may be obtained in any district by any company, companies, or person; and in the construction of this Act the term "the undertakers" shall be deemed to include any such company, companies, or person.

Where the undertakers require powers for the purpose of constructing gas-works or water-works, or works connected therewith, within any district, the consent of the local authority of such district shall be necessary before any provisional order can be obtained; and where in such district there is a road authority, distinct from the local authority, the consent of such road authority shall also be necessary in any case where power is sought to break up any road of such road authority, before any provisional order can be obtained, unless the Board of Trade in any case in which the consent of the local authority or road authority is refused are of opinion, after inquiry, that, having regard to all the circumstances of the case, such consent ought to be dispensed with, and in such case they shall make a special report, stating the grounds upon which they have dispensed with such consent.

Notices and Deposit of Documents by Promoters as in Schedule. 24 & 25 *Vict., c.* 45; 25 & 26 *Vict., c.* 12.

5. The undertakers intending to make an application for a provisional order in pursuance of this Act shall proceed as follows:—

(1.) On or before the first of November next before their application they shall give notice in writing of their intention to make the same to every company, corporation, or person (if any) supplying gas (if the proposed application relates to gas-works) or water (if the proposed application relates to water-works) within the district to which the proposed application refers.

(2.) In the months of October and November next before their application, or in one of those months, they shall publish notice of their intention to make such application by advertisement, according to the regulations contained in Part I. of the Schedule (B) to this Act; and where it is proposed to abstract water from any stream for any water-work, they shall give notice in writing of their intention to make such application to the owners or reputed owners, lessees or reputed lessees, and occupiers of all mills and manufactories or other works using the waters of such stream for a distance of twenty miles below the point at which such water is intended to be abstracted, such distance to be measured along the course of such stream, unless such waters shall within a less distance than twenty miles fall into or unite with any navigable stream, and then only to the owners or reputed owners, lessees or reputed lessees, and occupiers of such mills and manufactories as aforesaid which shall be situate between the point at which such water is proposed to be abstracted and the point at which such water shall fall into or unite with such navigable stream; and such notice shall state the name (if any) by which the stream is known at the point at which such water shall be immediately abstracted, and also the parish in which such point is situate, and the time and place of deposit of the plans and sections required by this Act to be deposited.

(3.) On or before the thirtieth day of the same month of November they shall deposit the documents described in Part II. of the same schedule, according to the regulations therein contained.

(4.) On or before the twenty-third day of December in the same year they shall deposit the documents described in Part III. of the same schedule, according to the regulations therein contained.

All maps, plans, and documents required by this Act to be deposited for the purposes of any provisional order may be deposited with the persons and in the manner directed by the Act of the session of Parliament held in the seventh year of the reign of His late Majesty King William IV. and the first year of Her present Majesty, intituled "An Act to compel clerks of the peace for counties and other persons to take the custody of such documents as shall be directed to be deposited with them under the Standing Orders of either House of Parliament;" and all the provisions of that Act shall apply accordingly.

Power for Board of Trade to determine on Application and on Objection. 24 & 25 *Vict., c.* 45; 25 & 26 *Vict., c.* 19.

6. The Board of Trade shall consider the application, and also any objection thereto that may be lodged with them on or before such day as they from time to time appoint, and shall determine whether or not the undertakers may proceed with the application.

Power for Board of Trade to make Provisional Order.

7. Where it appears to the Board of Trade expedient and proper that the application should be granted, with or without addition or modification, or subject or not to any restriction or condition, and it has been proved to their satisfaction that all the requisitions of section 5 of this Act have been in all respects complied with, the Board of Trade may settle and make a provisional order accordingly.

Every such provisional order, if it relates to gas-works, shall expressly restrict the undertakers from manufacturing gas or any residual products arising in the manufacture of gas on any land except such as is specified in that behalf in the order; and shall also expressly restrict them from storing gas on any land, except such as is specified in that behalf in the order, within 300 yards from any dwelling-house existing at the time when the undertakers propose to store gas on such land, without the consent in writing of the owner, lessee, and occupier of such dwelling-house.

Form and Contents of Provisional Order. 24 & 25 *Vict., c.* 45; 25 & 26 *Vict., c.* 19.

Every such provisional order shall contain such other provisions as, according to the nature of the application and the facts and circumstances of each case, the Board of Trade thinks fit to submit to Parliament for confirmation in manner provided by this Act; but so that any such provisional order shall not contain any provision for empowering the undertakers or any other person to acquire lands otherwise than by agreement, or to acquire any lands, even by agreement, except to an extent therein limited.

Costs of Order. 24 & 25 *Vict., c.* 45; 25 & 26 *Vict., c.* 81.

The costs of and connected with the preparation and making of each provisional order shall be paid by the undertakers, and the Board of Trade may require the undertakers to give security for such costs before they proceed with the provisional order.

Publication of Provisional Order as in Schedule.

8. When a provisional order has been made as aforesaid and delivered to the undertakers, the undertakers shall forthwith deposit and publish the same by advertisement according to the regulations contained in Part IV. of the Schedule (B) to this Act.

Confirmation of Provisional Order by Act of Parliament. 24 & 25 *Vict., c.* 45; 25 & 26 *Vict., c.* 19.

9. On proof to the satisfaction of the Board of Trade of the completion of such publication as aforesaid, the Board of Trade shall, as soon as they conveniently can after the expiration of seven days from the completion of such publication, in relation to any provisional order which shall have been published as aforesaid not later than the twenty-fifth of April in any year, procure a bill to be introduced into either House of Parliament for an Act to confirm the provisional order, which shall be set out at length in the schedule to the bill; but until confirmation by Act of Parliament a provisional order under this Act shall not have any operation.

If while any such bill is pending in either House of Parliament a petition is presented against any provisional order comprised therein, the bill, so far as it relates to the order petitioned against, may be referred to a select committee, and the petitioner shall be allowed to appear and oppose as in the case of a bill for a special Act.

The Act of Parliament confirming any provisional order under this Act shall be deemed a public general Act.

Incorporation of General Acts in Provisional Order.

10. The provisions of the Lands Clauses Acts shall be incorporated with every provisional order under this Act, save where the same are expressly varied or excepted by any such provisional order, and except as to the following provisions, namely:—

(1.) With respect to the purchase and taking of lands otherwise than by agreement.

(2.) With respect to the entry upon lands by the promoters of the undertaking.

Where a provisional order authorizes a gas undertaking, the provisions of the Gas-Works Clauses Act, 1847, shall be incorporated with such provisional order, save where the same are thereby expressly varied or excepted.

Where a provisional order authorizes a water undertaking, the provisions of

the Water-Works Clauses Act, 1847, and of the Water-Works Clauses Act, 1863, shall be incorporated with such provisional order, save where the same are thereby expressly varied or excepted.

For the purposes of such incorporation a provisional order under this Act shall be deemed the special Act.

Cesser of Powers at Expiration of Prescribed Time.

11. If any undertakers empowered by any provisional order under this Act to make works do not, within three years from the date of such provisional order, or within any shorter period prescribed therein, complete the works; or,

If within one year from the date of the provisional order, or within such shorter time as is prescribed in the provisional order, the works are not substantially commenced; or,

If the works are commenced, but whilst the powers to carry them on exist are suspended without a reason sufficient in the opinion of the Board of Trade to warrant such suspension;

the powers given by the provisional order to the undertakers for executing such works, or otherwise in relation thereto, shall cease to be exercised, except as to so much of the same as is then completed, unless the time be prolonged by the special direction of the Board of Trade.

A statement in writing by the Board of Trade to the effect that such works have not been completed, or that the works have not been substantially commenced, or that they have been suspended without sufficient reason, shall be conclusive evidence for the purposes of this section of such non-completion, non-commencement, or suspension.

Gas-Rents and Water-Rates in Schedule.

12. The undertakers empowered by any provisional order under this Act may demand and take, in respect of gas or water supplied by them under the authority of such provisional order, rents and rates respectively, not exceeding the sums specified in such provisional order, subject and according to the regulations therein specified.

Company not exempt from Provisions of General Act.

13. Nothing in any provisional order or Act confirming the same shall exempt the undertaking, or the company, corporation, or person to whom it belongs, from the provisions of any general Act of Parliament relating to gas-works or water-works passed after the passing of this Act, or from any revision or alteration under the authority of Parliament of the maximum rents and rates allowed to be taken under the provisional order.

Queen in Council may substitute any Department for Board of Trade for the purposes of this Act.

14. For the purpose of carrying into effect the provisions of this Act, it shall be lawful for Her Majesty, at any time after the passing of this Act, by Order in Council, to substitute for the Board of Trade any other department of Her Majesty's Government, and from and after such time as may be specified for the purpose in any such order, or, if no time be specified therein, from and after the date of such order, all matters to be done in pursuance of this Act by or in connexion with the Board of Trade shall be done by or in connexion with such substituted department.

Act not to apply to Metropolis.

15. This Act shall not apply to any place within the metropolis, as the same is defined in the Metropolis Management Act, 1855.

SCHEDULE A.

Districts of Local Authorities.	Description of Local Authority of District set opposite its Name.
England and Wales.	
Boroughs (1.)	The mayor, aldermen, and burgesses, acting by the council.
Any place other than a borough, and under the jurisdiction of commissioners, trustees, or other persons intrusted by any local Act with powers of improving, cleansing, or paving any town.	The commissioners, trustees, or other persons intrusted by the local Act with powers of improving, cleansing, or paving the town.
Any place not included in the above descriptions, and within the jurisdiction of local board constituted in pursuance of the Public Health Act, 1848, and the Local Government Act, 1858, or one of such Acts.	The local board.
Any place or parish not within the above descriptions, and in which a rate is levied for the maintenance of the poor.	The vestry, select vestry, or other body of persons, acting by virtue of any Act of Parliament, prescription, custom, or otherwise, as or instead of a vestry or select vestry.
Scotland.	
Places within the jurisdiction of any Town Council, and not subject to the separate jurisdiction of Police Commissioners or trustees.	The Town Council.
In places within the jurisdiction of Police Commissioners, or trustees exercising the functions of Police Commissioners, under any general or local Act.	The Police Commissioners or trustees.
In any parish or part thereof over which the jurisdiction of a Town Council or of Police Commissioners, or trustees exercising the functions of Police Commissioners, does not extend.	The Parochial Board.
Ireland.	
The city of Dublin	The Right Honourable the Lord Mayor, aldermen, and burgesses, acting by the Town Council.
Towns corporate, with exception of Dublin.	The mayor, aldermen, and burgesses, acting by the Town Council.
Towns having commissioners under an Act made in the 9th year of the reign of George the Fourth, intituled "An Act to make provision for the Lighting, Cleansing, and Watching of Cities and Towns Corporate and Market Towns in Ireland in certain cases."	The commissioners.
Towns having Municipal Commissioners under 3 & 4 Vict., c. 108.	The Municipal Commissioners.
Towns having Town Commissioners under the Towns Improvement (Ireland) Act, 1854 (17 & 18 Vict., c. 103), or any Acts amending the same, or under any local Act.	The Town Commissioners.
Townships having commissioners under local Acts.	The Township Commissioners.

(1.) "Borough" shall mean any place for the time being subject to an Act passed in the session holden in the fifth and sixth years of the reign of King William the Fourth, chapter seventy-six, intituled "An Act to provide for the Regulation of Municipal Corporations in England and Wales."

SCHEDULE B.

Provisional Orders.

Part I.

Advertisement in October or November of intended Application.

(1.) Every advertisement is to contain the following particulars:—

1. The objects of the intended application,
2. A general description of the nature of the proposed new works, if any.
3. The names of the townlands, parishes, townships, and extra-parochial places in which the proposed new works, if any, will be made.
4. The times and places at which the deposit under Part II. of this schedule will be made.
5. An office, either in London or at the place to which the intended application relates, at which printed copies of the draft provisional order when deposited, and of the provisional order when made, will be obtainable as hereinafter provided.

(2.) The whole notice is to be included in one advertisement, which is to be headed with a short title descriptive of the undertaking.

(3.) The advertisement is to be inserted once at least in each of two successive weeks in some one and the same newspaper published in the district affected by the proposed undertaking, where the proposed works, if any, will be made; or if there be no such newspaper, then in some one and the same newspaper published in the county in which every such district, or some part thereof, is situate; or if there be none, then in some one and the same newspaper published in some adjoining or neighbouring county.

(4.) The advertisement is also, in every case, to be inserted once at least in the London, Edinburgh, or Dublin *Gazette*, accordingly as the district is situate in England, Scotland, or Ireland.

Part II.

Deposit on or before the 30th of November.

(1.) The undertakers are to deposit—

1. A copy of the advertisement published by them.
2. If the application relates to gas, a map showing the land proposed to be used for the manufacture of gas, or of residual products arising in the manufacture of gas.
3. A proper plan and section of the proposed new works, if any, such plan and section to be prepared according to such regulations as may from time to time be made by the Board of Trade in that behalf.

(2.) The documents aforesaid are to be deposited for public inspection—

In England or Ireland, in the office of the clerk of the peace for every county, riding, or division; in Scotland, in the office of the principal sheriff clerk for every county, district, or division which will be affected by the proposed undertaking, or in which any proposed new work will be made.

(3.) The documents aforesaid are also to be deposited at the office of the Board of Trade.

Part III.

Deposit on or before the 23rd of December.

(1.) The undertakers are to deposit at the office of the Board of Trade—

1. A memorial signed by the undertakers, headed with a short title descriptive of the undertaking (corresponding with that at the head of the advertisement), addressed to the Board of Trade, and praying for a provisional order.
2. A printed draft of the provisional order as proposed by the undertakers, with any schedule referred to therein.
3. An estimate of the expense of the proposed new works, if any, signed by the persons making the same.

(2.) They are also to deposit a sufficient number of such printed copies at the office named in that behalf in the advertisement; such copies to be there furnished to all persons applying for them at the price of not more than one shilling each.

(3.) The memorial of the undertakers (to be written on foolscap paper, bookwise, with quarter margin) is to be in the following form, with such variations as circumstances require:—

[*Short title of undertaking.*]

To the Board of Trade,

The memorial of the undertakers of [*short title of undertaking*]:

Sheweth as follows:—

1. Your memorialists have published, in accordance with the requirements of the Gas and Water-Works Facilities Act, 1870, the following advertisement:

[*Here advertisement to be set out verbatim.*]

2. Your memorialists have also deposited, in accordance with the requirements of the said Act, copies of the said advertisement, and [*Here state deposit of the several matters required by Act*].

Your memorialists, therefore, pray that a provisional order may be made in the terms of the draft proposed by your memorialists, or in such other terms as may seem meet.

A.B.,
C.D.,
Undertakers.

Part IV.

Deposit and Advertisement of Provisional Order when made.

(1.) The undertakers are to deposit printed copies of the provisional order, when settled and made, for public inspection in the offices of clerks of the peace and sheriff clerks, where the documents required to be deposited by them under Part II. of this schedule were deposited.

(2.) They are also to deposit a sufficient number of such printed copies at the office named in that behalf in the advertisement, such copies to be there furnished to all persons applying for them at the price of each.

(3.) They are also to publish the provisional order as an advertisement once in the local newspaper in which the original advertisement of the intended application was published.

HOUSE OF LORDS.

Monday, Aug. 1, 1870.

The following Bills received the Royal Assent:—The Reading Local Board of Health; Rotherham and Kimberworth Local Board of Health; St. Helen's Gas; Enniskillen Borough Improvement; and the Oldham Corporation Water, &c.

Tuesday, Aug. 2.

The Blackburn Corporation Improvement Bill was returned from the Commons, with the amendments agreed to.

Saturday, Aug. 6.

The Gas and Water Facilities Bill.—The Commons reason for disagreeing to one of the amendments made by the Lords was considered. The amendment to which the Commons disagreed was not insisted on, an amendment made, and the Bill returned to the Commons.

Monday, Aug. 8.

The Gas and Water Facilities Bill was returned from the Commons, with the amendment agreed to.

Tuesday, Aug. 9.

The following Bills received the Royal Assent:—The Gas and Water Facilities, and the Blackburn Corporation Improvement.

HOUSE OF COMMONS.

Wednesday, Aug. 3, 1870.

The Gas and Water Facilities Bill.—The Lords amendments were considered, several agreed to, and one disagreed to.

Monday, Aug. 8.

The Gas and Water Facilities Bill.—The Lords amendment agreed to.

HOUSE OF LORDS.

(Before Lord WALSINGHAM, *Chairman; Viscount* POWERSCOURT, *Lord* SALTERSFORD, *Lord* DUNSANY, *and Lord* HEYTESBURY.)

BLACKBURN CORPORATION IMPROVEMENT BILL.

TUESDAY, JUNE 21.

Mr. VENABLES, Q.C., Mr. MICHAEL, and Mr. TAHOURDIN appeared for the promoters, the Blackburn Corporation; Mr. RODWELL, Q.C., and Mr. LITTLER in support of a petition by Edward Petre, Esq.; and Mr. MILWARD in support of a petition by Sir William Henry Fielden, Bart, in opposition.

Mr. VENABLES, in opening the case for the promoters, said their lordships would find this a case in the highest degree deserving of their consideration. It was a matter of vital importance to the town of Blackburn, and was likely to be of great public and national importance as a precedent in similar cases. The bill was substantially, so far as concerned the contested part, a bill for applying the sewage irrigation scheme to Blackburn, and it also referred to other matters, upon which, as they were not opposed, he did not intend to address their lordships at present. It had become absolutely necessary for the town of Blackburn to provide some efficient means of disposing of its sewage. The greatly altered condition of the sewage works which had taken place in late years had in very many instances created a great nuisance, because there was now a concentrated evil in the form of a main drain, consisting of the river into which the sewage was effectually carried, but out of which there were no means of taking it. The town of Blackburn contained in round numbers 80,000 inhabitants. A few years ago the system of sewerage in Blackburn was very much like that in most towns—*i. e.*, there were a few sewers. No doubt a certain amount of pollution escaped into the Blakewater—a small river running by the town, which fell into the Darwin, and ultimately the Ribble—but generally the sewage was somehow got rid of on the spot, and the river was then comparatively pure. Of course, Blackburn would, sooner or later, have improved its sewage works, but no great improvement was made until the time of the great cotton famine, when Parliament passed Acts enabling the Public Works Loan Commissioners to advance money to the governing bodies of the Lancashire towns for the purpose of employing the artisans who were out of work. Blackburn suffered more than almost any other town in Lancashire from the cotton famine, in consequence of the nature of the fabric on which the town is employed, and the corporation, acting with a very creditable energy, spent in public works for the relief of the distress about £145,000, of which about £90,000 was devoted to the sewage. Twenty-two miles of sewers were laid down, carrying off the sewage into the Blakewater. The sewage was taken into the river, and it was said by those persons who were interested that after a time it created a considerable nuisance. In 1866 several of the neighbouring proprietors gave notice that they required the nuisance to be abated. The corporation made additional exertions to obviate the nuisance, but not to the satisfaction of the persons affected, and in December, 1865, a bill was filed in Chancery by Sir Henry Fielden (who also acted on behalf of several other neighbouring landowners) to restrain the corporation from discharging their sewage into the Blackwater. The case was heard in June, 1866, before Vice-Chancellor Wood, who gave a decree in accordance with the plaintiff's prayer. The corporation gave notice of appeal, and it was arranged that the decree was not to be enforced pending the hearing of the appeal. In 1866, and early in 1867, the corporation moved the court to advance the hearing of this matter, they being anxious to avoid all delay; but the appeal was not heard till November, 1867, when the Lord Chancellor directed that the parties should agree upon some skilled person who should examine certain works, and should see whether or not the nuisance could be abated without an absolute decree preventing the corporation from doing it, and Mr. Rawlinson, the eminent engineer, was ultimately appointed. The corporation prosecuted various works, and the legal proceedings were from that time suspended until Mr. Rawlinson should give his report. That report had not yet been given, but it was well known to be against the corporation, and although they used their best exertions to get rid of the nuisance without absolutely diverting the sewage, they knew that the Court of Chancery would decide in accordance with Mr. Rawlinson's report. He proposed to call Mr. Rawlinson, to state that the only way the nuisance could be got of rid was by the plan proposed in the present bill—viz., by taking a large quantity of land, and sending the sewage over it in the way of irrigation, and so removing it from the river. This litigation had rendered it imperative for the corporation to find some other means of disposing of the sewage. Nor was this the only expense to which they were exposed, for Sir William Fielden, at the commencement of the present year, served them with notice that he was about to bring an action for the same matter—the pollution of the river—and that he should lay the damages at £20,000. This action was so far advanced that it was probable it might be tried at the next summer assizes. The corporation had also received notice from an owner of a house which he stated had remained some time unlet in consequence of the pollution, and he also required damages for the injury. It was very singular that the only petitioners against the bill were Sir William Fielden, the plaintiff in the Chancery suit and the other action, and Mr. Petre. He did not deny Mr. Petre's right to oppose, but it so happened that Mr. Petre was one of the gentlemen who gave notice to the corporation to remove the sewage from the river, and who made arrangements with Sir William Fielden for costs in the respective proceedings; therefore these gentlemen were estopped from saying the sewage ought not to be removed from the river. They had insisted that it ought to be removed from the river, and it only remained for them to say that something else ought to be done. This being the case, the corporation would have been exceedingly glad to avoid any unnecessary outlay, after the very heavy expenses they had of late years incurred; but it was incumbent upon them to make this outlay, and they had, without any selfish interest, carefully considered the matter with the best advice obtainable, and that advice coincided with what was the almost universal scientific opinion—viz., that the only practicable plan was that of irrigation. He had a list of thirteen inquiries that had been instituted by Royal Commissions and select committees of the House of Commons, and they all had resulted in approval of the irrigation system. Nor was this all. The Government had lately appointed two commissions, one of which was now sitting, and which had made a preliminary report, to inquire into the pollution of rivers. Of the first of these commissions Mr. Rawlinson was chairman, and of the latter one Sir William Denison was chairman, and Dr. Frankland was a member, and they had already issued a report which materially bore upon this question. They made experiments which went into all the alternative methods of disposing of sewage, especially the chemical methods, of which there were three or four, for precipitating the sewage, and turning the noxious contents into solid manure. The result of their experiments and of the evidence which they took was that nothing could be done which would be so effectual as irrigation. [The learned counsel proceeded to quote the report at great length.] A great many pages of it were occupied with the results of various chemical processes. After instancing towns where the ashpit process had been experimented on, the report stated it had proved a conspicuous failure, both as to the manufacture of valuable manure, and the purification of offensive liquid. With regard to Sillars' (or the "A.B.C.") and the lime processes, it described Sillars' as the better of the two, but that neither process effected its purpose, so far as making the water admissible into a river. As to the process of downward filtration, it went on to say there were three formidable objections to the general adoption of that system. It was entirely unremunerative; the whole of the manure ingredients would be absolutely wasted; and the collection of solid fœcal matters upon the surface of the soil, with no negotiation to make use of them, would probably cause a great nuisance, especially in hot weather. With reference to the irrigation system, the report spoke at great length of the advantage of it, and said: "Considered, then, merely as a mechanical and chemical agency for cleansing the drainage water of our towns, it seems plain that a sufficient extent and depth of porous soil to be used in irrigation, having periodical intervals of rest, during which the soil drains, and becomes refilled with air, certainly must be the best strainer, oxidizer, and filter of water, which, like the sewer water of our towns, contains nauseous organic impurities both suspended and dissolved. That it is so, analyses of effluent waters have satisfactorily proved, as will be illustrated at length hereafter. Meanwhile, we have further to consider the last great advantage of the soil over all other filters, in that it utilizes a considerable proportion of the substance, which they only separate, or at least transform." It then went into several cases where it had been tried, and at page 90 it said: "Nowhere have we found instances of ill health that are properly attributable to malaria or other causes due to irrigation." The report also referred to the present case: "At Blackburn, where filtration, subsidence-tanks, and the lime process have done literally nothing in the way of abating the nuisance, the corporation are considering the possibility of carrying their sewage some miles down the river side, so that by natural gravitation it shall flow over the large extent of grass land, perfectly well adapted for it, between Blackburn and Walton-le-Dale," that being the very land proposed to be taken under this bill. The report included in its recommendations the following:—That, subject to proper regulations to prevent abuse, additional powers be given to corporations, local boards, manufacturers, and others, to take land compulsorily under 'provisional order,' for the purpose of cleansing sewage or other foul liquids, either by irrigation, filtration, or otherwise, and to obtain, if required, easements for the construction of culverts and outfalls for drainage through private property, making compensation only for damage actually done, reserving however to the owner the right at any time afterwards, if he could show further damage, to have further compensation." This was the last recommendation to the Government, who, having appointed those eminent persons to consider the subject, would in all probability adopt their recommendation. Within three years Parliament had passed two Acts—the Sewage Utilization Act, and the Amended Sewage Utilization Act—the objects of which were to enable governing bodies to take land compulsorily by a provisional order for the purpose of sewer irrigation. The corporation might have applied to take the land under a provisional order, but there were a great many objects in the bill, and it was much more convenient to include the whole matter in one bill. When a general bill, such as the Railway Clauses or the Railway Facilities Bill, was passed, it was an assertion that railways on the whole were desirable things, and exactly in the same way Parliament had already resolved that facilities ought to be afforded to take lands compulsorily for this very purpose of irrigation. Even if Parliament had decided wrongly (which was an extreme supposition) the corporation could only act upon the authority of Parliament, of the Government, and of the different official bodies who have reported upon the matter. If they had adopted any other plan they would still have the nuisance remaining, and any person aggrieved coming to the proper tribunal, that tribunal would have taken notice of the affair. "This corporation having had notice of thirteen inquiring bodies, of Parliament having passed Acts for the purpose, and of the opinion of the last and, therefore, most authoritative commission, have wilfully and perversely adopted an inferior plan; they ought to have adopted an irrigation plan, and, therefore, they are specially liable to all the consequences which may arise from their adoption of an inferior plan." It was undoubtedly an inconvenience of the irrigation system that it necessarily required large quantities of land lying together. It might generally be taken to require one acre for every 100 inhabitants. Of course it was a greater hardship to a proprietor to be deprived of a large piece of his estate than to be deprived of a smaller piece occasioned by the passage of a railway through his land, and, of course, that was taken into consideration in the compensation given. All the corporation could do was first to fix upon a piece of land adapted to the purpose; and, secondly, to select a place where it could do no damage whatever. Preston was about nine miles westward of Blackburn. Of course they were obliged to go downhill, because sewage would not flow uphill. They were obliged to follow the course of the river, and they could not get further from Blackburn without getting nearer to Preston, and, of course, the objections to coming near another large town would be as great as those to taking lands in their own vicinity. They proposed to take 1140 acres. There was every reason to expect that in the next ten years the population would rapidly increase, and, therefore, in common prudence, they calculated the works to meet such increase. They also took powers (which probably would not be required for many years to come) to acquire land, if necessary, by agreement. The compulsory powers were limited. Out of the 1140 acres there were really only 650 to deal with, the owners of the remainder not objecting to the scheme. The outlying land proposed to be taken belonged to Mr Petre. There was no residence upon the property. It was agricultural land, remarkably well adapted to the purpose; and by good fortune it happened that the other part of Mr. Petre's estate, which he will retain, is separated from it by the high road, and was in a different direction, and would be unaffected by the till. The land was on a slope, which would enable the sewage to be used to the best possible advantage. They could not have gone nearer either Blackburn or Preston. The works would be constructed in the best possible manner, and advantage would be taken of all recent discoveries. The real creation of wealth produced by irrigation was a matter of public importance, and there was no process in modern times that produced anything like the wealth this system did, and the increase of produce was enormous. The corporation did not take into consideration commercial profit. The works and lands were to cost £189,000, and would, no doubt, get a certain revenue by letting the land to tenants. So far the case appeared a one-sided one. The corporation would take all the nuisance out of the river, would get rid of the litigation both of Sir William Fielden and Mr. Petre, would replace all persons on the banks of the Blakewater and Darwen in a much better position than they were before the sewage works were constructed, because the water would not be fouled at all, and so the scheme was an unmixed advantage to every person concerned. With regard to Sir William Fielden's petition, the pipe would go under his estate, so that it would not affect his property in any way whatever; but of course he would be entitled to compensation for the disturbance of the ground, and for the easement. With reference to Sir William Fielden's river rights, he had one small corn-mill on the Darwen, and what he stated was that, instead of their water running into the Blakewater, which he said did him £20,000 damage by running in the form of sewage, this corn-mill would be damaged. The water supply of Blackburn came from a company which had its supply from the east of Blackburn. When that supply was authorized, Sir William, or his predecessor, was compensated for the water, and that water primarily belongs to Blackburn and to nowhere else. Really Sir William Fielden was not injured in the slightest degree. He (Sir William) proposed that if the scheme was sanctioned there should be provision to supply tanks for distributing sewage to the proprietors of adjacent lands. No doubt there would be no objection to letting him have the sewage. Mr. Petre's petition was more important, because, no doubt, he would suffer a great loss. No doubt he had, as his petition stated, improved the land. It was only agricultural land, and as perhaps not two houses had been built in 30 years, between Preston and Blackburn, it could not very well be called building land. Mr. Petre also objected to the bill as "inflicting great and unnecessary annoyance" on himself, and "very seriously affecting the value of his whole estate." By this scheme it happened that it would have the reverse effect; it would consolidate the estate and diminish the grievance. It was now cut up in all directions. It would give him a much shorter boundary, and there would be no unnecessary severance. The petitioner went on to submit "that

the powers and provisions of the Lands Clauses Consolidation Acts are wholly inapplicable to a purchase of the extent and nature contemplated by the corporation; that they were, in fact, intended and are adapted only to the construction of a work or works through a property." That was not a question for the committee but for Parliament. Parliament had chosen to legislate in a particular manner, and had not chosen to restrict its legislation, and therefore to make that assertion was to go against the legislation of the country. The petitioner objected "that the period for purchasing lands and completing the works, which are now by clauses 68 and 70 extended to three and seven years, are so long as to show that the corporation have not yet determined what works to execute, nor what lands they really intend to take under the powers of the Act." That was a matter of detail. The three years for taking the land was all that Mr. Petre was concerned with, because it was no concern of his how long the corporation were executing the works when he had once parted with his land. The reason for taking seven years to construct the works was simply because they could not be all done at once. The reason was that the rates were exceedingly heavy, and the liabilities under this Act would bring them up to 7s. in the pound. A great part of the population being poor, it was thought desirable to increase gradually the necessary rating. Mr. Petre, like Sir William Fielden, said this plan was not the best, and therefore the onus was thrown on the corporation to show that it was the best. Witnesses would be called, on behalf of the corporation, whose authority was very high. There would no doubt be witnesses called on the other side, but unless the case for the petitioners was very much strengthened since it was in the House of Commons, where it underwent a most careful investigation, he could hardly doubt that his plan would meet with their lordships approbation. Mr. Petre, in paragraph 15 of his petition, alleged that "other lands might be taken for the purpose with greater advantages of efficiency and economy to the town, and without inflicting injury and annoyance on your petitioner." If he thought any spot was better, he ought to have defined it in his petition. The learned counsel concluded his address by saying that he would show that there were insuperable objections to taking any land nearer Blackburn, and he said there were obvious objections to taking it nearer Preston; and as to going into any unknown country beyond Preston, he entirely objected to entering into that question. The corporation having used their best discretion, were not only bound to sustain positively that this was land suitable to their purpose, but that the taking of it was not seriously injurious to the owner from whom it was taken.

Mr. *Thomas Hardy Pickup*, examined by Mr. TAHOURDIN.

I am mayor of Blackburn, and am a member of the Town Council. I was one of the Improvement Commissioners previous to the incorporation of Blackburn. I have been chairman and vice-chairman of the Finance Committee for a considerable number of years. The cotton famine seriously affected the borough before 1861. That led to the employment of the factory operatives there, and to the expenditure of more money than we should otherwise have been obliged to incur. There is considerable necessity for an enlargement of the time for repaying the loans. I am well acquainted with the general improvements provided for in the bill, and I think they are decidedly necessary. I think the plan introduced by the corporation, providing for the disposal of the sewage, most suitable. I think it is imperative, in order to avoid the present inconvenience to the town I think Mr. Petre's land is suitable for that purpose.

Cross-examined by Mr. LITTLER: The distance of that land from the parliamentary boundary of Blackburn is, perhaps, about three and a half to four miles, and is about five miles from the centre of the town. It is three miles from Preston. There is a good road running through it. Building is increasing in the town of Blackburn, but not in the neighbourhood. It is spreading on the Preston Road. With regard to the spot in question being the most suitable for Blackburn, I have not examined any other land for the purpose. Blackburn is supplied both with privies and water-closets. The good houses have water-closets, and the poorer houses have the old-fashioned privies. There are about 20,000 cottages. There are houses of £20 a year, and there are water-closets in houses of that rental. All the cottages under £20 a year have ashpits.

Mr. LITTLER: I see that by this bill you take powers to compel the owners to cover in the ashpits, and all that sort of thing. I suppose that you would not put them to that expense if you were going very shortly to convert those ashpits into water-closets?

Witness: They make this class of ashpits to drain into the sewer.

Re-examined by Mr. VENABLES: We have at any rate sufficient drainage of the liquid sewage to cause it to be objectionable. In my opinion the use of water-closets should be increased, and is increasing. Even from the ashpits there is a good deal of drainage which has to be removed, and which is being gradually drained into the sewer.

By a LORD: The population of Blackburn at the last census was 63,000, but now we consider that it is 80,000.

Mr. *Charles G. H. Beck*, examined by Mr. VENABLES.

I am town-clerk of Blackburn, and have held that office more than five years. I have the notice which was originally served on me. It is dated Dec. 9, 1865. It is as follows:—"We, the undersigned, to the mayor, aldermen, and burgesses of the borough of Blackburn, for and on behalf of Sir Henry de Hoghton, Bart., Sir William Henry Fielden, Bart., Joseph Fielden, Esq., M.P., Edward Petre, Esq., John Cooper, Esq., Ralph Assheton, Esq., and Edward Rodgett, Esq., the owners and occupiers of lands and other property upon certain streams of water called the Blakewater and the river Darwen, or one of them, both in the county of Lancaster, do hereby give you notice that we are instructed by them to take proceedings against you, for turning and discharging the sewage and other offensive matters arising within the said borough into the said stream called the Blakewater, and which sewage and other offensive matters flow from such stream into the said stream called the river Darwen, whereby the said several streams were fouled, rendered impure, unwholesome, and offensive. and the respective properties of the said several persons upon the said several streams, and the occupiers thereof, are materially injured. Dated Dec. 9, 1865. R. and W. Ascroft, attorneys, Preston." I replied to it. The notice was followed by a bill in Chancery, dated January, 1866, filed by Sir William Fielden. That is the bill of complaint referred to, and the prayer is in substance that the corporation shall be enjoined not to discharge the sewage into the Blakewater. Our answer to the bill in Chancery was filed in April, 1866, and it contained a statement as to the belief of the defendants that they believed that these other gentlemen were parties to the litigation. The answer was a voluntary answer, and interrogatories were filed. In the plaintiffs answers to these interrogatories, there was an admission that although the other parties named were not the plaintiffs, there was an arrangement as to the contribution for costs. The case came on for hearing in June, 1866. Before it came on, we had given notice to these owners of our intention to make some improvement. It was as follows:—"To Sir Henry de Hoghton, Bart., Sir William Henry Fielden, Bart., Joseph Fielden, Esq., M.P., Edward Petre, Esq., John Cooper, Esq., Ralph Assheton, Esq., and Edward Rodgett, Esq., the owners and occupiers of lands and other property upon certain streams of water called the Blakewater and the river Darwen, or one of them, both in the county of Lancaster; and to Messrs. Robert and William Ashcroft, of Preston, in the same county, their attorneys. I, the undersigned, for and on behalf of the mayor, aldermen, and burgesses, are about to construct upon land at Wensley Fold, in the township of Wilton, in the said county, tanks for the reception and treatment of the contents of the sewers of the said borough, and that drawings of the proposed works, showing their nature and position, are now prepared, and may be inspected by you at the office of the borough surveyor at the town-hall in Blackburn aforesaid, within 14 days from the service hereof, and that unless you notify to me in writing, within 21 days from the service hereof, any objections you may have to urge against the construction of such works, in accordance with the said drawings, you will be deemed to have approved of such drawings, and consented to such proposed works. Dated this 18th day of May, 1866. (Signed) Charles G. H. Beck, town-clerk of Blackburn." After the hearing of the case, the decree was that the corporation should be restrained from the 2nd of November, 1866, from turning in or allowing any offensive matter to be turned into the stream from any sewers under their control. We then appealed to the Lord Chancellor. I believe two motions were made to advance it out of the ordinary course, but it was not heard until November, 1867. Lord Chelmsford suggested that the appeal should stand over, and that some scientific person, to be agreed on by both parties to the suit, should report as to the efficiency of the work constructed. Mr. Rawlinsón was selected. The works had been proceeded with in the meantime, but they were not completed. Mr. Rawlinson has not reported; the works have been in operation. My attention has been called to the passage in the commissioners report stating that these works have been a complete failure. Whatever Mr. Rawlinson's opinion was, the corporation had notice of it, and, on Mr. Rawlinson's strong recommendation, have resolved on proceeding on this irrigation scheme. Mr. Rawlinson gave detailed evidence in the House of Commons in support of this scheme. Although the matter had been hanging so long over the plaintiffs in Chancery, I am not aware they made any attempts to push it on. Either the defendant or plaintiff might have applied to court if he had thought proper, but neither having done so, it may be said that the final decision has been adjourned by consent. We are exposed to further litigation in the shape of an action by Sir William Fielden, in which he has laid his damages at £20,000. We have pleaded, and it is ready to join issue. We have received the following notice from James Bradley Stones:—"To the Mayor, Aldermen, and Councillors of the Borough of Blackburn. Gentlemen,—I hereby beg to intimate that the estate of my late brother, Mr. George Stones, is suffering loss by a house, situated at Pleasington, being unoccupied on account of the nuisance arising from the river passing near the house, caused by the pollution from the Blackburn sewage. The last tenant left the locality on account of the nuisance referred to, and several applicants have declined to take it for the same reason. The trustees purpose claiming compensation for the loss and damage, and respectfully suggest that some means be adopted for coming to an amicable arrangement. We should, if deemed advisable, be glad to meet a committee upon the business. Waiting an early reply, I am, yours obediently, James B. Stones." This is dated May 30, 1870. There are several riparian proprietors, who, if they thought proper, might proceed against us in the same manner as Sir William Fielden and others have done.

Mr. VENABLES: And you have no practical means of meeting such litigation except by diverting the sewage from the river. You are subject to such litigation.

Witness: Yes; whether it is well founded or not. The corporation fixed upon Mr. Petre's land during the summer of last year, and we immediately communicated with his agent, Mr. Drysdale. We laid our scheme before him, and we went for the purpose of hearing any suggestions which he might have to offer with the view of avoiding any hostility, and he wrote on the 25th of October last as follows:—"Dean Cottage, Bolton. Dear Sir,—Blackburn Sewage. I have communicated with Mr. Petre about your proposal of taking the sewage to his estate at Samlesbury, and having given the matter some consideration myself, I am of opinion that if carried out it would be a great injury to the estate, on account of the large portion you would take, and your cutting into the very centre of it. I do not think that less than £4 per statute acre per annum on a long term would compensate Mr. Petre for the loss. Of course you will understand that I am not binding myself to take this price, or any other, before having an opportunity of giving Mr. Petre a full description of your plans, &c.—I am, yours very truly, J. Drysdale." I answered that letter on the 2nd of November, as follows:—"Dear Sir,—Blackburn Sewage Utilization. I laid your letter of the 25th ult. before the committee. The rental you name seems very high, and I trust, when you become more perfectly acquainted with the scheme, you will see your way to advise Mr. Petre to let the corporation have such land as it requires on far easier terms. The corporation will probably apply to Parliament for powers to purchase, but not exercise them if land can be rented on fair terms.—Yours truly, Charles C. H. Beck, town-clerk. J. Drysdale, Esq., Dean Cottage, Bolton." On the 6th there was another letter from Mr. Drysdale:—"Dear Sir,—I received your letter of the 2nd inst., and you appear to think my price for the land at Samlesbury high, but, of course, I do not know exactly as yet, nor does Mr. Petre, all the corporation may want. I am going to Samlesbury on Tuesday first, if your surveyor or others could meet me there in the afternoon of that day—say two o'clock—I could learn more about your scheme." The 9th of November being the day of the municipal election, I wrote to Mr. Drysdale to say that it was impossible that anybody from the corporation could meet him on that day. I served the landowners with notice before the 30th of November. On the 3rd of December I sent the formal notice to Mr. Petre. On the 28th of January I wrote a letter to Mr. Petre's solicitors, in reply to one from them, asking for copies of the bill as deposited, in which I said, "I trust that there will be no opposition on Mr. Petre's behalf. I believe it is the intention of the surveyor to see Mr. Drysdale, and ascertain how far he, as Mr. Petre's agent, can further the object sought to be obtained by the bill." Soon after that Mr. Petre deposited his petition. After that I again wrote to ask his terms. We were anxious to settle the matter amicably if we could. No definite terms were offered to us. We ultimately found by the petition, and by Mr. Petre proceeding with the petition, that he was opposing the bill altogether.

Cross-examined by Mr. LITTLER: The earlier letters were before the deposit of the bill, and before we had given notice to the landowners of the amount of land we intended to take. Very few people out of the Town Council knew what we exactly did intend. With regard to Sir William Fielden's claim of £20,000, that amount no more shows what Sir William Fielden was anxious to get than if £20 had been put. With regard to the Chancery proceedings, the plaintiff is not pressing us in any way.

Re-examined by Mr. VENABLES: There is nothing to prevent the plaintiffs pressing their suit on at any time they like; if it suited their purpose they would do so. I imagine they could press for Mr. Rawlinson's report.

Mr. *M. M'Manus*, examined by Mr. MICHAEL.

I am the borough surveyor of Blackburn. I have gone over the figures given in the preamble of the bill, and they are correct. The present rateable value of the borough is £185,000. The present total rates collected in the pound are 6s. 1d., consisting of improvement and sewers rate 3s. 1d., and poor-rate at about 3s. The 3s. 1d. produces to the corporation about £25,000 net. We have to pay for a sinking-fund on the moneys we have borrowed; the interest is about £9500 a year. We have also to pay one-thirtieth part of £144,135 borrowed from the Public Works Commissioners, and the interest upon it at 3½ per cent., which makes about £4500 a year in payment of principal alone. The remainder of the rates goes to removing nuisances, cleansing ashpits, and the general improvement of the borough. We seek to borrow under this bill £235,000. The corporation will have to pay in total about £18,000 annually when the term of their payments is extended from 30 to 70 years, as is sought by this bill. The result will be a slight increase in the rates, but not so great as if we had to pay in 30 years. In the latter case it would bring us to between 8s. and 9s. The total rates will be under 7s. if this bill is granted. It is certainly desirable that the rates should be kept down to the lowest possible amount. For five or six years there has been very great

METER HOUSE, PHOTOMETER ROOM, OFFICE & LABORATORY

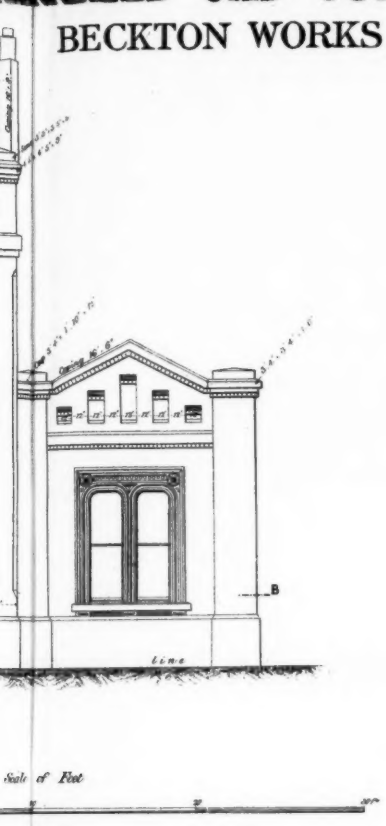
CHARTER
BE

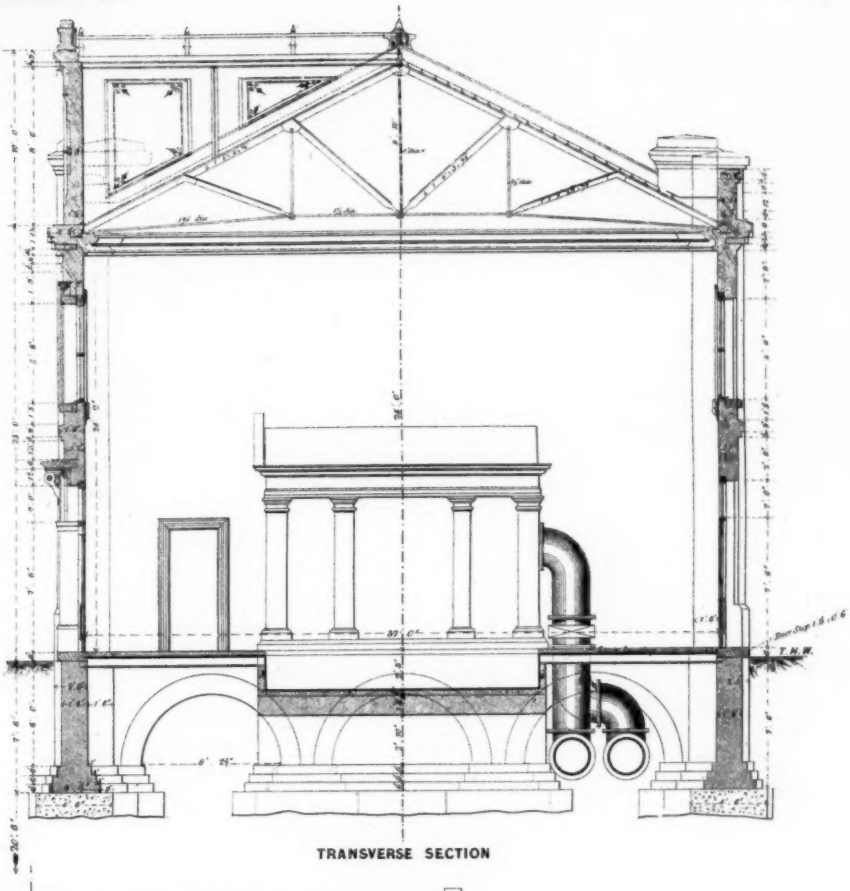
Photo-Lithographed by Whiteman & Bass, London

...ATFORD GAS COMPANY.

BECKTON WORKS.

Nº8





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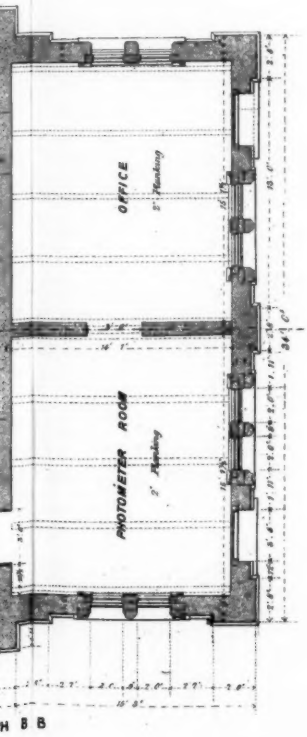


HALF BACK ELEVATION

distress in the borough, and for five or six years to come the people will not be able to recover themselves. The *corpus* of the property upon which the money is expended for permanent improvement remains for future generations, so that really we are paying off our principal year by year, the benefit of which will remain for those who come after us. This sum of £144,135 was raised entirely for the relief of the sufferers from the cotton famine. That was a burden which was imposed on the town by that misfortune. We were in a dilemma; we were obliged either to find work for the operatives or to let them starve; and we found work, the price paid for which was very much above its value, and therefore, in order to prevent the operatives starving, the borough incurred a debt which was very much greater than they otherwise would have done. We do not ask by this bill for any extension of time at which the Town Commissioners are to be repaid. We have expended £54,000 for the town-hall, park, and market. This is municipal property, and we think it ought to be charged in the municipal department of the accounts, and we believe, by this consolidation of rates, a great expense is saved in assessment and collection. We shall be able to do it at very much less expense by adopting the principle in the bill.

Cross-examined by Mr. LITTLER: If our scheme is sanctioned, perhaps 2d. or 3d. will be added to our rates at the beginning of the 70 years. We do not estimate the rates as being 6s. for 70 years to come if we get power to borrow. We shall have an increased population, and we have done work for the future population. We have made miles of sewers. The rates will diminish; we have expended money which will enable us to have 100,000 inhabitants to pay the rates. It may be a burden of 6s. for 70 years to come, supposing the population does not increase.

Re-examined by Mr. MICHAEL: We have already paid off a large portion of the money. We are paying interest year by year upon a smaller portion. We have paid out of the sewer-rates £18,000 odd, and out of the improvement-rate £28,000, and we have repaid to the Public Works Loan Commissioners over £15,000, which makes upwards of £60,000 in 15 years.

Mr. Frederick Smith, examined by Mr. MICHAEL.

I am the borough surveyor of Blackburn. I have measured all the works executed under the Towns Improvement Act. The amount expended under that Act was £68,000, and it included 12 miles of sewers, sewage outlet works, and tanks for the settlement of the solid matter, including 10,000 square yards of land, and sheds, and works; the straightening of the river, and sundry other matters; compensating owners for going through private land, and acquiring private property for the permanent purposes of the works. We have also made several improvements on the river Blakewater. We had to straighten it, build walls each side of it, and to pitch the bed for nearly half a mile with large stones of about 18 inches square. We improved the roads to the outlet works by taking the solid sludge away. We also carted away certain stuff. Our expenditure under the Public Works Loan Commissioners was £144,000. Those works were executed under my superintendence, and under the direction of a committee of the Blackburn Corporation. The latter were directed and inspected by Mr. Rawlinson and Mr. Arnold, his assistant. Everything was strictly done in accordance with their instructions, but under my superintendence and direction. We executed 22 miles of sewers at £39,687 17s. 3d., pitched the river at £3066 18s., expended on bridges £851 10s. 7d., extending and laying out new roads in the park £2615 1s. 3d., house drainage £3000, and public baths £6000. For materials we have £2000 in stock, and we have works in progress of the value of £16,485 2s., which makes up the £144,135. That money was advanced in sums of £10,000 each. Those works have been a great advantage to the town in a sanitary view. Previously the river was what might be called an open sewer for the whole borough, and the whole drainage of the town ran into it. It is now all cut off, and the river is, comparatively speaking, a pure stream running into the borough, and it discharges the whole of the sewage below it; and a great portion of the borough which was formerly only partially drained, or not drained at all, is now thoroughly drained and ventilated. It is a perceptible improvement to the town in every respect. Our position with regard to the long percolation of sewage matter into the soil is much more satisfactory than it was. We have acquired various powers for compelling the owners of property to improve ashpits, and so on, and we are gradually carrying those improvements out. As regards the flood of the Blakewater, we have materially relieved it from the nuisances which formerly existed. The present works for defœcating the sewage consist of five long tanks 125 feet each, 17 feet 6 inches wide at the top, and about 6 feet at the bottom, with filters and other matters, and the sewage is run through them, and all the solid matter in suspension is detained. We return nearly 70 tons weekly of sludge, which is given to the farmers in the district. We use lime. It does not act as a precipitant, but it lessens the smell. The volume of the sewage is mainly the water used by the inhabitants for domestic purposes supplied to them by the water-works company. I should think 13,500 out of the 15,000 houses within the borough are supplied by the water-works company. They have power to supply townships adjoining, the total number of houses being about 17,000. That company built one reservoir to compensate the river Darwen, at present turning down 5 feet per second for the 12 working hours. None of the water from that reservoir gets into Blackburn. Before the construction of our present sewers about one-sixth of the present volume of water passed into the Blakewater. The town was only imperfectly drained by old stone soughs, and one-half of the sewage made its way through, and percolated through the ground, so that the soil became saturated with sewage matter. That was extremely injurious to health, the ground under the houses becoming logged with fluid sewage. That cannot take place under the present system. The sewers are self-cleansing, with sufficient fall, and everything is carried clean away.

By a LORD: The width of the Blakewater is only about 20 feet. The supply is 400,000 gallons, or one-fifth of the volume of the sewage. It runs very rapidly; there is about 30 feet of fall from one end of the borough to the other.

By Mr. MICHAEL: There is at present a great excess of water in the Blakewater below the outlet works to what formerly existed there, owing to the drains taking all the water away, and our having a more perfect supply from the water-works company. I believe the Darwen has a better supply than it formerly had in dry weather, because the water now used for domestic purposes ran through the Darwen in storms and floods. Now, in dry weather, there is a regular flow of 5 feet per second. I do not think we had that quantity before in dry weather. In spite of all we have done, the Court of Chancery have held that our works are insufficient, therefore I was instructed by the corporation to see what better scheme could be devised for removing the nuisance complained of. I made myself master of everything done beforehand on the subject of sewage utilization, and I came to the conclusion that irrigation was the only manner in which we could get out of our difficulties. I then spent about twelve months in examining the whole district to ascertain the best and most feasible site. I visited many places where sewage irrigation is carried on, and at Chorley I have watched the working for the last two years. I have carefully examined the district, so as to select proper land for a sewage irrigation farm, and the result is that I have found the land now scheduled as the most appropriate for the purpose. [Witness explained by reference to the plan the mode of carrying the sewage and distributing it on the land.] The conduit is underground all the way; at one place 5 feet below the surface. It will be a permanently closed sewer, water-tight, to prevent intercepting any water. The length of the conduit is about 4 miles 6 furlongs. There is not much of it along public roads. There is, perhaps, 3 furlongs at the extreme end. The extreme end of the land is about 6 miles from Blackburn and 3½ miles from Preston. There are no buildings extending in this direction.

By a LORD: When we get the sewage on to this ground we shall have some of it pasture land. From this point we should make open carriers to distribute it. We should let the land if we could arrange with a gentleman who would work the sewage under the conditions of clarifying it before letting it go into the river.

By Mr. MICHAEL: The conduit is capable of taking about 4 million gallons, or nearly double the present quantity. We propose to take 1140 acres of land for the purpose. Mr. Petre has 1500 acres of ground in this direction besides this. [Referring to plan.] The soil of it is about 9 inches in depth, and underneath that there is about a foot which is nearly half sand and half clay, or at least 40 per cent. is sand, and underneath that it is stiff clay. There is quite 2 feet of porous soil. We shall never have all our land irrigated at once. I believe that irrigation will be successful on both our kinds of land. One acre to 100 persons is the quantity of land generally considered, but this scheme is equal to 70 persons to an acre. There is no other suitable land, unless we go some 15 or 16 miles from Blackburn. There are great objections of a residential character to our taking any other land. One great object has been to avoid doing injury to resident landowners. We do not intend to take any of Sir W. Fielden's land for irrigation purposes; we only require lands within the limits of deviation for a water-tight sewer-pipe, and that cannot possibly inflict any injury to the land. Very little of that land is under cultivation; it is mostly pasture. From here to here [referring to plan] are two deep ravines; this little bit of ground belongs to another landowner. The land is certainly not fit for building, and never will be; there are some very poor, narrow roads to it. The nearest house on Sir W. Fielden's estate from the proposed irrigation grounds is half a mile in a straight line. It is much farther than Mr. Johnson's place, who is favourable to the scheme. Sir W. Fielden will have power under this bill to take sewage to distribute over his lands, if he pleases. It will not interfere with his water right. It will not abstract any of the water of the Blakewater, or divert any of the natural drainage of the river. I have been many times over Mr. Petre's ground. It is cultivated very little. A very small portion of it joins the turnpike road. The other portion is traversed by very poor, rugged, hilly roads; one conveyance cannot pass another on them. It is not at all likely to be built over. There is a difficulty of getting water for domestic purposes on it. The distance from the nearest railway station is two miles. The population in that district has decreased from 1400 to 1200. The acreage of the township is 4379 acres. No new buildings have been erected on it for the last 20 years.

By a LORD: The land is principally in grass; I do not think it is worth 10s. a year. It might be made valuable by spending money. Some of it is not fit for cattle feeding.

By Mr. MICHAEL: I believe the estimate of £189,000 for carrying out these works would be quite sufficient.

Cross-examined by Mr. LITTLER: There are streams, but they are not fit for domestic purposes. The water in them is rather better than the Blakewater, where our sewage goes in. I consider, from what I have noticed in the Chorley irrigation farm, where it is still stiffer clay than this, that it clarifies the sewage, and is successful in every way except where the drains are imperfect. We take power to wait, if we like, for three years before we give the notice. I could execute the whole of the works, perhaps, in two years. I do not know that the present agent has had more than one application for building land. It is not suitable for building gentlemen's houses. I calculate the expense of the works and preparing the land at 47,000, and for the whole of the land £142,000. The first piece is Sir Henry de Hoghton's. He did oppose, but we have come to terms with him. I know that the soil of Carlisle is so porous that they do not require any irrigation drainage there. I have experienced a slight smell when walking over irrigated lands, but very faint. I generally made my investigations in summer, when the land is capable of absorbing most. I never noticed any smell in the Croydon works. It is no part of our scheme at present to convert the 10,000 privies of the town into water-closets. We propose to make the people make them water-tight—to cover them in—in future buildings; as to the present buildings we drain them. The land on this plan [produced by Mr. Littler] to the north I do not think is suitable, because of the many valuable residences there. That in this direction [pointing it out] is much more valuable land—that is one consideration; another consideration is that it will be costlier to carry our sewer to this point, because the distance is much longer. Here you come upon little villages and mills, and it is much likelier to be built upon, because it is nearer to the railway. Ours is between the two. I do not think that land is as good in any respect. When you get near to a valuable residence, the land round it is much more valuable; there is residential property in the neighbourhood, and it would be very expensive and very impolitic to buy land there. I should not think it an annoyance to have an irrigation farm near my house if it were well managed.

Mr. LITTLER: As to the privies and water-closets, the 35th section of this bill provides "a privy or water-closet, and sufficient ashpit accommodation, shall be provided for every house. No privy shall be made within five feet of any dwelling-house or other habitable building, and in cases where this space cannot be secured, a water-closet or water-closets must be provided. No room for human occupation shall be made over a privy, cesspool, or ashpit; all ashpits and cesspools shall be covered in, and sufficient means of ventilation for the same provided to the satisfaction of the surveyor." That governs past and present, as it appears to me.

Witness: That is so. When the cesspools are covered in, a part of the liquid nuisance will be obviated—that which arises in wet weather; but there is a good deal of liquid put in cesspools besides that. It would obviate it as far as rain water goes. Sir Henry de Hoghton was paid one hundred guineas to withdraw his petition.

Re-examined by Mr. MICHAEL: Under an Act of 1854 we have the power to convert the privies into water-closets, when the corporation think it desirable in the interests of the public to do so. That does not fall on the general rateability of the borough, it is a private improvement at the expense of the owner. I think we should have much more difficulty in getting the land that has been pointed out to us than that which we seek under this bill. We intend to execute the powers as we are ready, in order to utilize the sewage to the greatest advantage. Therefore we are not to expend the whole of the money at once, but to have three years, which the committee of the other House granted to the corporation for the exercise of those powers. It is a short time as compared with the period we have had before granted to us. We cannot put sewage on land till it is prepared to carry off the effluent water.

Mr. *John Lawson*, examined by Mr. MICHAEL.

I am a civil engineer, living at Westminster. I have carried out sewage works at Cockermouth, Workington, Lancaster, and Bedford; water-works at Bedford; sewage irrigation at Bedford, Tunbridge Wells, Ormskirk, and other places. I am consulting engineer for similar works at Reading, and for these works under this bill. I have examined the existing sewage-tanks at Blackburn, and there is no question that they intercept a considerable amount of solid matter from the sewage, but the effluent water as it leaves the tanks is quite unfit to flow into a stream. Some extra works are undoubtedly necessary, in order to meet the exigencies of Blackburn. I think the most perfect mode of dealing with sewage and purifying it is by applying it in a liquid state to the land; in fact, by sewage irrigation. I have, in conjuction with Mr. Smith, laid out the works which are the subject of this bill. They must, of course, remove the nuisance in the Blakewater, because they take the entire sewage from it. I believe they are the best works that could be devised for this district. The con-

duit will not inflict the slightest damage beyond that temporarily done to the surface while the works are in progress. Sewage could be distributed from the conduit on to the lands of any owner who wished to avail himself of the benefit of it, and some powers are taken for that purpose. I have examined the district, and I have not seen any land better situated for the purpose, either with regard to residual damage or to the absence of building land in its neighbourhood. The land is not so well suited to sewage irrigation as some I have seen, but it is tolerably suited for that purpose. I believe there will be no difficulty in successfully carrying out a sewage farm when the ground is properly prepared. The water-works company take power to take a certain quantity of water from certain streams, and they compensate the millowners upon those streams for the water so taken. Having compensated them, they have a right to take the water down to the sea if they like, without turning it into the Darwen. That is the very water that would be abstracted by this sewage—the water that would be used by the inhabitants, and afterwards converted into sewage. The estimate for these works is adequate.

Cross-examined by Mr. RODWELL: This is the only mode in which the sewage can be dealt with to the best of my information. I believe the time will very soon come when every town in England will have to get rid of its sewage by irrigation. I think a landowner should be compelled to part with his land for irrigation purposes. I have inspected towns where schemes other than irrigation schemes are carried on. I know that the water supplied to the East London Company and the New River Company comes from the stream into which the sewage of Hertford and Luton is discharged, after undergoing the process of filtration. I believe Higgs's system—the lime process—is used in those two towns. I have seen it at Leicester. I cannot account for the fact that the sewage after being exposed to that process is allowed to pass into the London water supply. I would rather leave it to the chemists, who have analyzed the effluent water, to give you a description of it. There is no process—neither the lime process nor the so-called A. B. C. process, nor the process in operation at Northampton—which, in my opinion, purifies sewage to anything like the extent that irrigation does. I know the system at Leamington. Judging from the results of the analyses made by some of the first chemists, the solid matter manufactured at Leamington is nearly valueless as manure. I think in the present case the soil is not quite so well adapted for the purpose as the one at Bedford—for instance, that is a gravelly subsoil, and therefore does not require drainage. This is soil, sand, and clay to the depth of about 18 to 20 inches, and below that, over a considerable part of the area, it is a clay subsoil. It does not follow that directly water gets to the clay it stops there; it goes through the fissures in the clay, and drains are put in with a view to carrying the water to those fissures. The water stops at the clay if it is undrained. I would drain this land probably 4 feet deep. In every field there would be a difference in the width between the ground, because the subsoil varies. In some cases the clay is less stiff than in others. It is never so stiff as London clay. I agree with Dr. Frankland generally with regard to the pollution of rivers.

Mr. RODWELL: Look at this passage, at page 96: "Looking only to the purity of effluent water, it would be difficult to decide between downward intermittent filtration on the one hand, and irrigation on the other." Do you agree with that?

Witness: Yes. Perhaps it would be well to finish the sentence.

Mr. RODWELL: "But there are obvious reasons why the latter must, in all but rare and exceptional instances, be preferred on economical grounds. Intermittent filtration is a costly process, with no possibility of any return; whilst irrigation, although it may, in the first instance, require a larger outlay of capital, affords a hopeful prospect of a return for the capital invested." Are you still of opinion that it is a mere matter of expense whether you adopt this irrigation scheme, or the intermittent filtration scheme?

Witness: But the intermittent filtration scheme is only reported on as the result of laboratory experiments. Sewage irrigation, on the other hand, is reported on as the result of working the sewage of a town, and I have Dr. Frankland's own statement that this is simply a laboratory experiment; and he himself, if he were put in this box, would say that the sewage irrigation is preferable to the intermittent filtrations, because it has been tried in a large scheme and the other has not.

Mr. RODWELL: At page 128 he says: "It has been shown, by the experiments carried out in our laboratory, that a properly conducted system of intermittent filtration will cleanse town sewage sufficiently to enable it to be used for all but domestic purposes." Do you agree with that?

Witness: I suppose I must. He gives the result of his laboratory experiments.

Mr. RODWELL: "The previous treatment of the sewage by one of the chemical processes already described would, however, obviate this liability to nuisance, whilst it would properly reduce to one-half the size of the filter necessary for cleansing a given volume of sewage. Such a combination of a chemical method with intermittent filtration offers the most hopeful process, both as regards economy and efficiency, in cases where irrigation is impracticable."

Witness: Yes, exactly. Will you read the next sentence?

Mr. RODWELL: "In all practicable cases, however, we strongly recommend the adoption of irrigation in preference to filtration, for, when irrigation is carefully and properly conducted, not only is the polluted water rendered inoffensive, but a return of profit is derived from its employment." I asked you before an abstract question, independently of economy and expense, whether there was any scheme by which sewage could be purified, and you have told me repeatedly "no." Having read that, is your opinion modified at all?

Witness: It is modified to this extent—I say irrigation is the most satisfactory mode of dealing with and purifying sewage. Our justification in coming for this bill is that there is no other practicable mode of dealing with the Blackburn sewage.

Re-examined by Mr. VENABLES: My opinion coincides with the commissioners at page 128, when they say, "An acre of filtering material, 6 feet deep, used intermittently, will cleanse the drainage water of only 3300 people, at least;" as also "that, from a remedial point of view, it is successful; but, as sewage possesses a high agricultural value, this method of treatment would be very wasteful, and only to be recommended on a small scale, or where circumstances render any other process extremely difficult or expensive. Moreover, it is not unlikely that the operation, involving as it does the exposure of large and offensive filtering-beds to the air, would be itself attended with much serious nuisance." I do not know where a town of this size would get the land from for such a large extent of filtering-beds. They would have to be covered over at whatever expense. These beds would, after all, leave the solid sewage to be disposed of somehow. If not carried away by water, it must be carried away by some kind of conveyance. If it is to be used, it must be put on the land, and if it were put on the land and became moistened by the rain, it would produce a smell much more offensive than the application of fresh sewage in a liquid form. The sewage farm at Norwood is London clay. It is a stiffer and less porous clay than this, and nevertheless the result is very satisfactory. The sewage sticking fast, as soon as it got to the water-bearing level of the clay would be corrected by deep drainage. In the Lea Conservancy Act, 1868, it is provided that the town of Luton may continue to use a certain process; it appears that Luton objected to the irrigation scheme, and they got this clause that they might be allowed to do this. Section 101 of that Act provides that nothing shall prevent the local board maintaining their present sewage and drainage works, or from discharging into the Lea the sewage after it has been purified by Higgs's process, or some other process which from time to time may be the best then practically known. It also provides that they shall not increase the sectional area of their present works, therefore I suppose it would appear that if Luton increased they would not be entitled to apply this process of purification to the sewage works which would be rendered necessary in the new part of their town. My opinion is that filtration on a great scale would be exceedingly wasteful, and that irrigation is greatly preferable.

Mr. *Joseph Brierley*, examined by Mr. TAHOURDIN.

I am a civil engineer, resident at Blackburn. I was engineer to the Blackburn Corporation for about eight years, and am acquainted with the proposed sewage scheme. I believe the scheme now devised to meet the corporation difficulties is well matured, and best calculated to fulfil its purposes. I think the locality is suited for the purpose of irrigation. Being a member of the committee upon whom devolved the duty of selecting a site, I can say we went indiscriminately over the whole of the country lying below the sewer outfall, and we selected this as being the most advantageous under all circumstances. It is best adapted on account of its contiguity to the town. The expense of continuing the conduits would have much increased if we had gone further. I have visited several towns where irrigation is carried on—Barking, Edinburgh, Carlisle, Banbury, Bedford, Croydon, Aldershot, Harrogate, and other places. My opinion is that the only solution of the sewage difficulty is to be found in the immediate application of fresh sewage to the land, and that has been carried on so successfully in so many places, that it almost appeared to me as if the problem of successful sewage irrigation was already quite solved. A special element in the success is that there has been no offensive smell from the land, or nuisance attending it whatever.

Cross-examined by Mr. MILWARD: The Blakewater is the sole drainage of the Blackburn valley. Before the sewage system of the corporation was carried out, the entire refuse water of the town was discharged into the river at a great many points, and formed a portion of the body of the stream. It flows past Sir W. Fielden's mill. By the present scheme the refuse water will find its way into the river at a level lower than Sir W. Fielden's mill, and they will not have the advantage of that volume of water for the purpose of turning the water-wheel.

Cross-examined by Mr. LITTLER: I made inquiries at Croydon, and found that no one in the neighbourhood complained of any nuisance. I put my hands in the effluent water. I smelt and tasted it, and saw little fishes enjoying themselves in it. I have been to the irrigation works at Edinburgh, and they only fail in one particular—that is, the manner in which the irrigation is conducted. The operation is slovenly. The trenches are excavated in the ordinary ground, forming miniature canals, along which the sewage runs, and they are diverted by channels simply formed in the earth; naturally some deposit takes place in those, and no doubt there is a degree of offence, which might be easily avoided. I think the question is for the corporation to deal with the filth, irrespective of its commercial success. The cost of our works is a very serious amount. Although we do not aim at it, I have no hesitation in saying these works will be remunerative. I believe at Bedford this is the case, at which place they cut five crops of grass an acre, yielding from 15s. to 16s. per ton, and the cost is simply the application of the sewage. We are assuming that the application of sewage to the land will develop its best properties. I think the supervision of the corporation will be sufficient to ensure that it will be properly worked. At Carlisle the soil is quite an open gravel. There is no necessity for subsoil drainage there. As the sewage is discharged a few drops of carbolic acid is dropped into it previously to its being let out. The areas are shifted, but the distribution of sewage goes on incessantly, and must of necessity, for the reason that it has to be pumped out of a sewage well. The construction of houses near the works goes on without diminution. The rainfall here is about 42 inches in the year. If you drain clay land two processes take place—not only do you carry away the water from the surface, but there is a very great action due to atmospheric influence; those dense clays become cracked and filled with fissures, and as the land is improved from time to time, that which is excessively dense and impervious clay in time becomes so filled with these fissures as to become a porous soil. Then, with respect to the excessive moisture due to the winter climate, you have this fact—viz., the low temperature. As to frost, the temperature of sewage is much above that of ordinary water. The Blackburn sewage is a fair quality. It may not have half the constituents of London sewage, because London has water-closets, and in Blackburn they are not the general rule. Croydon is a water-closet town; Carlisle is not. I think it would be an exceedingly foolish thing to attempt a chemical process with an intermittent filtration at Blackburn, for the reason that if you have lands lying in favourable situations for irrigation purposes that certainly presents a solution of the question at once; but if you begin with chemical manipulation you only extract it in the solid form, which you have to apply to the land afterwards as manure, whereas in the irrigation process the sewage is carried fresh to the land, appropriated by the herbage, and converted into food at once. If you take the manufacturing districts in Yorkshire you find a difficulty in dealing with the sewage, and some of those towns are now experimented upon on the A. B. C. process, simply because there are no areas in those immense populations available for irrigation works.

Re-examined by Mr. VENABLES: Sir William Fielden would be deprived of no other water except that which comes from the Blackburn Water-Works transformed into sewage, and for that the persons who are entitled to it have already been compensated. I know of no "mills" except the corn-mill. If it should turn out that he has any right to this water which would be abstracted from him, that will give him a claim to compensation. At Carlisle there are villas some 60 or 70 feet higher in level than the irrigation ground on which they look. If there was any unwholesome or unpleasant exhalation from the ground, they are just at the level at which they would feel it most. In the present case there would be nobody at all to be incommoded by any such exhalation, if it existed, except an exceedingly sparse population.

By a LORD: Taking 18 or 20 gallons of water as being the quantity supplied to each head of the population per day, the sewage of the town might be applied to the land directly without any dilution. I am not aware that in Edinburgh they dilute the sewage with 20 times as much water.

Dr. *Alfred Carpenter*, examined by Mr. VENABLES.

I am a physician practising at Croydon, and have been a member of the Croydon Board of Health about eleven years. I have paid great attention to, and have published several papers on the subject of preventative medicine. We have two sewage farms, one at Beddington and one at Norwood. Our population now draining on our sewage farm is about 55,000, about 49,000 at the Beddington farm, and 5000 to 6000 at Norwood. We have 60 acres at Norwood, of which 23 or 30 only are at present under irrigation. The rest is being laid out. In consequence of the increase of the population we have extended the area. We shall have one acre per 100 persons. The soil at Norwood is the stiff London clay. Previous to our taking all the land which we have at present we were constantly under the threat of legal proceedings. We had to pay a considerable sum for damage in consequence of the sewage finding its way to property which we now irrigate, and since it has been in our hands we have had no charge against us whatever, but on the contrary an expression on the part of the inhabitants of satisfaction at the state in which it is. It has been reported to our board from official sources that the health of the district has materially improved since these irrigation fields have been established. Buildings have approached within 400 or 500 feet of the fields on either side. Complaints have been lodged by a gentleman a mile and a half from us. Those complaints were inquired into by an order of the Privy Council, and it was proved that the complaint was not fairly charged upon our works, but was due to stagnant ditches between the gentleman's house and our fields—out of our jurisdiction. We have at present 276 acres at Beddington, but we have this year secured 200 odd acres, so that we shall shortly have from 400 to 500 acres under irrigation. That will give nearly an acre to every 100 persons. That is, in my opinion,

the correct proportion. At the Sewage Congress, at Leamington, I moved a resolution in favour of irrigation, which was adopted by the meeting. Experience has shown me that no illness has arisen attributable to the sewage works at Beddington. There was an outbreak of typhoid fever at the Female Orphan Asylum, but it was due to internal causes. The same thing occurred at the Warehousemen and Clerks Schools, and from similar causes. Within 700 yards of the outfall sewers there is a dense population, among whom there was no typhoid fever whatever. I have observed with regard to Croydon, whenever we have had the wind change from north or east to west, it has always been followed by an improvement in the general health of the people. Contiguous property has greatly increased in value. The farm is extremely efficient, and produces most abundant crops. We have taken our 500 acres at £10 an acre.

By Mr. RODWELL: We let it at the same rent we pay for it.

By Mr. VENABLES: No unwholesome effect is caused to the consumers of the produce from the farm. These operations greatly increase, I think, the fertility of the land and the production of food.

Cross-examined by Mr. RODWELL: It has been a financial success as regards Norwood, and there has been no loss at Beddington. There is not a strong feeling in Croydon against these works. Within the last few weeks a feeling has been excited near the spot where the filth has been carried. I certainly do smell an unpleasant odour from these sewage works. The smell is strongest in the daytime, and depends on the state of the atmosphere. The outfall where the sewage first finds its way on the land as an open sewer must be necessarily unpleasant. There are some houses quite close, but the occupants have not complained. I do not think it is injurious to them. The sewage as it comes from Croydon is in a much fresher state than that which finds its way to the outfall at Barking. We do not pump at Croydon, it is by gravitation. The sewage merely passes through a filtering apparatus, and goes straight on to the land. I only referred to the wind to show it does not produced miasma. Wherever you have a large amount of vegetation, there you have a larger district producing oxygen in the air, and you have a better chance of pure air.

Re-examined by Mr. VENABLES: There must be much more putrescence in the long lead of the London sewers than in our short lead. Our sewers are supposed to be self-cleansing, but we have to flush them very frequently. By the outfall I mean the point at which the sewage comes upon the land. There must be this sewage somewhere or another. The complaint that has been made is from the effluent water, not from the outfall of the sewer, and the Blue-Books prove that the effluent water at Croydon is quite unobjectionable. If there was any point but at the outfall, where from any mismanagement or from an excess of sewage there was any nuisance, we would get rid of that by having a larger acreage.

(To be continued.)

Miscellaneous News.

BERLIN WATER-WORKS COMPANY.

The Half-Yearly General Meeting of the Berlin Water-Works Company was held on Tuesday, Aug. 9, at the London Tavern.

The 34th report stated that the net revenue for the past half year amounted to £31,960. If the receipts for the current half year were equally good, the earnings for the entire year would exceed 10 per cent. on the share capital. Under these circumstances the directors recommended the payment of an interim dividend for the past six months at the rate of 9½ per cent. per annum. The profits beyond 10 per cent. were to be divided with the Prussian Government, for constructing sewers in Berlin; but the board have always considered that the Government could not claim any portion of this surplus until the shareholders had received 10 per cent. on their capital from the opening of the works. However, during the present year the State Commissary had intimated to the representative of the company in Berlin that he claimed one-half of the earnings of the company beyond a sum sufficient to pay 10 per cent. on the share capital, so soon as such surplus arose in any one year. In this state of things the directors felt it right to communicate the circumstances to the shareholders, and to take their views upon the course to be pursued. The general revenue account showed a balance of £32,568.

The CHAIRMAN (Mr. Sim) said that the board had preferred to recommend 9½ per cent. instead of 10 per cent., as they might have done, on account of the state of affairs on the Continent. If adverse circumstances arose, the future dividend would not therefore suffer. Events, however, passed so rapidly, that perhaps there was less danger of this than there was a week ago. The works in Berlin were to a great extent underground, but the effects of war might interfere with them, and render the people unable to pay for water. Had the administration which made the concession remained in power, no doubt the works would have been sooner completed. The Government, however, had kept faith, but the Corporation of Berlin were not friendly to the company. The highest legal opinion in Berlin was favourable to the views of the report as to the Government claim upon the surplus. The board, however, did not wish to put the question to a legal issue, or to an arbitration which would be entirely German, but to yield the point for the sake of future advantages. He therefore, in moving the adoption of the report, moved also that the board should be authorized to make the best arrangements they could with the Prussian Government.

In reply to a question, the CHAIRMAN acknowledged that the Berlin people were jealous of the company, and would get rid of it altogether if they could.

Mr. PICKERSGILL-CUNLIFFE, in seconding the adoption of the report, said that the municipality of Berlin had made some very arbitrary demands; but the State Commissary had always kept them in check.

After a slight discussion, the report was unanimously adopted, with the remaining portion of the resolution, and the dividend as recommended was declared.

FIRST REPORT OF THE GAS REFEREES UPON THE SULPHUR QUESTION.

TO THE LORDS OF THE COMMITTEE OF PRIVY COUNCIL FOR TRADE.

Office of the Gas Referees,
23, New Street, Spring Gardens, July 13, 1870.

The referees have the honour to submit to the Board of Trade the following report of their proceedings in that department of their duties which relates to determining a proper maximum for the sulphur impurity, in the case of the gas-works included under the Gas Acts of 1868 and 1869.

The referees have examined the various methods hitherto proposed, as well as those at present in use, for purifying gas from sulphur. The obstacle to the practical adoption of many of the proposed methods or patents of this kind has hitherto been, either that they inordinately diminish the illuminating power (the prime and fundamental quality of gas); or else the beneficial effect which they show when tried on the small experimental scale, alone possible for inventors, disappears or becomes wholly unreliable when they are applied in the only practical form—namely, on the large scale required in the manufacturing processes of gas works.

The hydrocarbons, which are the chief constituents of illuminating gas, do not exist in the stable form of chemical compounds, but are merely held in mechanical mixture or suspension in the gas—as sugar is in water. Hence every method of purification, which consists in passing the gas through various substances as through a sieve, tends to reduce the illuminating power, by abstracting from it the floating particles of the hydrocarbons. And it is found that every substance or process hitherto devised for entirely removing the sulphur compounds other than sulphuretted hydrogen, likewise takes out a large portion of the hydrocarbons—thereby destroying the illuminating quality, to an extent incompatible with the supply of gas to the public at ordinary prices.

As to the second cause of the break-down of numerous proposed processes for sulphur purification—namely, the fact that, although giving good results when tried on a small scale, the process fails when applied on a manufacturing scale—the referees have to remark that the efficacy of all purifying material depends mainly upon the length of time which the gas is in actual contact with it. And the difficulty under this head arises from the rapidity with which the gas has to pass out from the retorts to supply the public. Moreover, the present processes for sulphur purification are so defective (as will be shown in the sequel), that even doubling their extent in most cases produces no appreciable improvement in the purity of the gas. For example, the production of gas in summer is only one-half what it is in winter, while the purifying surface remains the same; nevertheless the referees find that this virtual doubling the extent of purifying material has had no appreciable effect in reducing the amount of sulphur in the gas of any of the companies. This fact, as regards the three companies included under the Act of 1868, is clearly shown by the daily testings now in force, which give the following averages of the amount of sulphur at mid-winter and at mid-summer (and the referees may add that the same state of matters prevails at the Fulham works of the Imperial Company):—

	Chartered.				City.		Central.
	Arundel Street.		Leadenhall St.	Gray's Inn.	Cannon Street.		Friendly Place.
	Cannel.	Common.	Common.	Common.	Cannel.	Common.	Common.
December, 1869 . .	21·8	27·4	22·8	24·2	9·4	20·4	14·7
June, 1870	22·3	30·3	20·4	25·2	13·4	18·8	13·3

The causes which determine the development and amount of the sulphur impurity in the gas issued to the public have not yet been adequately ascertained. Indeed, it is still uncertain in what form that impurity really exists in the gas. In the testings it is obtained, not in its original form as existing in the gas, but after the gas has been burnt, when the impurity becomes sulphurous acid. It is commonly said to exist in the gas as bisulphide of carbon; but the referees have reason to believe that whatever proportion of the impurity may exist in this form, it also does so in other forms. The best test yet discovered for the detection of bisulphide of carbon in gas is that of Hofmann—namely, triethylphosphine, which forms red crystals when acted upon by the bisulphide; and Mr. Kirkham, the experienced engineer of the Imperial Company, has informed the referees that (having obtained a small quantity of it from Professor Hofmann) he applied this test to gas containing a large amount of the "sulphur impurity" without getting any reaction indicating the presence of bisulphide of carbon. The manufacture of triethylphosphine is still a difficult and somewhat dangerous process, which few chemists are willing to undertake; but Mr. Kirkham, with the aid of his company, has constructed an apparatus for the manufacture of it, with the view of fully applying this test to determine to what extent the sulphur impurity really exists in the gas as bisulphide of carbon. It is needless to say that a correct knowledge of the actual form of this impurity in the gas is an important point in devising means for elliminating it in the process of purification.

It is an easy matter to rid gas of any impurity which is either an acid or alkali; but in whatever form or forms the sulphur-impurity exists in the gas it is certainly a chemical neutral; and hence one of the obstacles to catching it. There is little difficulty in dealing with ammonia and sulphuretted hydrogen, but the case is otherwise with an impurity like "sulphur," the very nature of which is still doubtful, and which as yet proves so little under the control of gas science.

Hitherto reliable experiments in purification on a manufacturing scale have been rare. Indeed, the importance of obtaining pure gas, in the interests of the public, has only recently been given effect to by legislation. Moreover, a series of such experiments, of adequate duration and conducted upon a systematic plan, demands a large amount of time and care; and, with few exceptions, the gas engineers of the metropolis are fully occupied in their ordinary work of gas-making. The circumstances of the various gas-works, and the processes in use, differ widely from one another—a circumstance in itself valuable when systematic experiments by a central body can be carried out in the works of each company, but which greatly lessens the value of mere isolated experiments (such as those hitherto carried on), however ably conducted. Under the Acts of 1868 and 1869, however, the referees, in pursuance of their duties and of the investigations required of them, are empowed to engage in inquiries and to employ workmen under their direction in the works of all the companies placed under their surveillance.* But the companies themselves have willingly undertaken to co-operate with the referees in this branch of their duties; and the engineers at the nine large gas-works included under those Acts are now acting together in co-operation with the referees, thereby giving a magnitude and reliability to the investigations in the matter of purity hitherto unattainable. Various sets of experiments on a manufacturing scale have been made, or are in process, on a uniform method prescribed by the referees, and of such duration as to give trustworthy results. Most important information will thereby be obtained; and there is every reason to believe that the chaos of opinion arising from the conflicting results of imperfect or isolated experiments will ere long give place to sound and certain knowledge, with great benefit to the purification of the gas and to the sanitary and other important interests of the public.

While experiments have been undertaken to ascertain the form in which the sulphur impurity actually exists in the gas, the referees have engaged in investigations to determine the relative efficacy of each of the separate stages of purification, and of each of the various processes employed by the companies, as regards the elimination of this impurity. The results already obtained are acknowledged on all hands to be of a most unexpected nature. First, as regards the "scrubbers." It has been currently believed of late that a most efficient means of purifying the gas from sulphur was to be obtained by "scrubbing," or washing with ammoniacal liquor. Indeed some authorities have publicly recommended that many thousand gallons of the liquor should be pumped into the scrubbers per hour. But the results of the referees experiments, as yet obtained, show that, whether or not this opinion be theoretically correct, it is totally wrong as regards the practical effects produced in the scrubbers in general use.

The experiments were made with the various kinds of scrubbers employed by the several companies. These scrubbers differ, to some extent, from one another in the arrangement of the scrubbing materials, especially as regards

* Clauses 34-36 of the Act of 1868 enact that the gas referees shall, "from time to time, inspect the works of the companies, and investigate the processes of manufacture carried on therein, with a view of ascertaining the means adopted therein for purifying gas and for preventing nuisance;" and that they "shall, from time to time, ascertain with what degree of purity each company can reasonably be required to make and supply gas continuously without occasioning a nuisance to the neighbourhood." "The companies shall give to the referees, and each of them, and to their clerks, servants, and workmen, access to the works of the companies; and shall, when required, afford to them and him all facilities for the proper execution of their and his duty."

the nature and the distribution of the liquid employed. They also differ as regards the substances with which the scrubbers are filled; in most cases, coke or fragments of brick being used, while in Mr. Livesey's scrubber (from which the best results were obtained) the substance employed is a network of thin boards of wood,—through which, as in the other forms of the scrubber, water or ammoniacal liquor trickles down slowly through the ascending current of the gas. The experiments were conducted on a uniform system, as follows:—Just before the gas entered the scrubbers a small portion of it was drawn off and made to pass through a box containing oxide of iron, so as wholly to remove the sulphuretted hydrogen; thereafter it was tested for sulphur. In like manner, as the gas emerged from the scrubbers, a portion of it was similarly drawn off, and after being purified from sulphuretted hydrogen, was tested for sulphur. The following summary will suffice for the present to show the results of these experiments, so far as they have gone:—

Results of Experiments for ascertaining the effect of Scrubbers upon the Quantity of Sulphur Compounds in the Gas.

	Average of	Amount of Sulphur at Inlet of Scrubbers.	Amount of Sulphur at Outlet.	Increase or Decrease at Outlet.
Great Central Co.	29 experiments	23·55	28·63	+5·06
Imperial Gas Co. (Fulham) .	26 do.	21·18	20·83	— ·35
Do. do. (St. Pancras).	4 do.	24·7	24·8	+ ·1
Do. do. (Shoreditch) .	3 do.	26·35	25·30	—1·5
City of London Co.	3 do.	22·86	25·41	+2·55
South Metropolitan Co. . . .	5 do.	33·03	28·98	—4·05
Chartered Co. (Westminster) .	11 do.	24·62	26·07	+1·45

Here it appears that only in one case did the scrubbers materially reduce the amount of "sulphur" (*i.e.*, sulphur compounds other than sulphuretted hydrogen), and that in the majority of instances *more* sulphur was found in the gas when it emerged from the scrubbers than before it entered them! These facts were so unexpected, and are so wholly contradictory of the long-established opinions and practice of gas engineers and consulting chemists, that one of the gas engineers tore up the results of his testings (which accordingly do not appear in the above table), thinking that he would only stultify himself by sending in such returns, which he fancied must be due to some mistake on his part—little expecting that they would be amply corroborated by the facts obtained by the other gas engineers engaged in the inquiry.

The extraordinary and wholly unexpected facts above-mentioned, the referees incline to believe, are due to some process as yet unknown and hitherto unsuspected, by which a portion of the sulphuretted hydrogen which enters the scrubbers is broken up as a chemical compound in passing through the scrubbing materials, and is converted into sulphur compounds other than sulphuretted hydrogen. Further experiments are being made with a view to determine this point of the sulphur question—namely, to what extent the "scrubbing" processes of purification can be relied on as a means of reducing the amount of the sulphur impurity; and by what changes some of the scrubbers at present in use can be freed from the objectionable results as regards sulphur which they now give.

Experiments of a similar character have also been instituted to ascertain the efficacy of the "purifiers" of various kinds in use in gas-works. The purifiers, consisting either of lime (wet or dry), oxide of iron, and occasionally sulphate of iron—and in some cases of all these combined—are specially designed to arrest and eliminate the sulphur impurity. So far as the referees experiments on this point have yet gone, the results are very disappointing. Reserving an adequate statement of the matter until this series of experiments is further advanced, the referees may state that, in regard to the purifiers, as in the case of the scrubbers, the gas in some cases *was found to contain more sulphur when it left the "purifying" material than when it entered it!* At one of the largest gas-works in London, where both oxide of iron and lime are employed in purification, a series of experiments carried on continuously for a month showed the following results:—

Sulphur per 100 Feet of Gas at Inlet of Purifiers.	Sulphur per 100 Feet of Gas at Outlet of Oxide of Iron Purifiers.	Sulphur per 100 Feet of Gas at Oulet of Lime Purifiers..
21·13 grains.	29·13 grains.	28·46 grains.

More sulphur in the gas after passing through the oxide of iron purifiers than on entering it	8 grains, or 37 per cent.
More sulphur in the gas after passing through both the oxide of iron and the lime purifiers.	7·33 grains, or 34⅓ per cent.

In this case the purifiers, which are designed especially to take out sulphur, were so far from fulfilling their object that the gas contained upwards of a third more sulphur on emerging from them than when it entered.

The following is another return, but from a different gas-work, in which all the processes of purification are included:—

——	1st Experiment.	2nd Experiment.	3rd Experiment.	4th Experiment.*	Average.
	Sulphur.	Sulphur.	Sulphur.	Sulphur.	
Inlet of scrubber .	23·6 grs.	23·9 grs.	25·6 grs.	25·7 grs.	24·7 grs.
Outlet of scrubber .	24·9 „	22·6 „	25·5 „	26·2 „	24·8 „
Outlet from wet lime purifier	25·0 „	24·0 „	25·1 „	26·3 „	25·1 „
Outlet from oxide purifier	24·1 „	25·2 „	24·6 „	22·0 „	24·0 „

* In the 4th set of experiments the gas was passed through dry lime after the oxide.

In this case the effects of the purifying process are actually *nil*, the gas having passed through all stages of purification without any diminution of its sulphur impurity.

The experiments, however, corroborate the long-established opinion as to the superiority of lime over oxide of iron as a purifier for the sulphur compounds. This is clearly shown by the results of the experiments, in possession of the referees, upon the gas made at the Great Central Company's works at Bow. Nevertheless, comparatively low as is the average amount of sulphur in that company's gas, the embarrassing *fluctuations* in its amount from day to day are even greater than in the case of those companies which use mainly or wholly the other kinds of purifying material.

There is no question as to the power of oxide of iron and lime to withdraw a large proportion of sulphur from gas under certain circumstances; but it is evident, from the facts already obtained in these experiments, that an adequate knowledge of how to apply these purifying materials in gas-works, so as to produce satisfactory results, has yet to be acquired. Laboratory chemistry is obviously at fault here. No appreciable advance has been made in sulphur purification during the last ten years, and the real means of improvement must be looked for in experiments on a manufacturing scale in the gas-works.

All the various processes of purification are completed before the gas enters the gasholders, where it is temporarily stored; but in considering the embarrassing question of the ceaseless daily fluctuations in the amount of sulphur—which constitute the most serious difficulty in fixing a *daily* maximum for this impurity, as required by the gas Acts—the referees saw reason to believe that at least some portion of those fluctuations might have its source within the gasholders themselves. In the course of his investigations, Mr. Kirkham, of the Imperial Company, discovered a thick film of oil on the surface of the water in some of his gasholders, and on withdrawing and analysing some of it, he found that it contained a considerable per centage of sulphur, and it is believed that this is by no means an exceptional case. Such a film is doubtless formed by condensation of gas in the gasholder; when so formed, on the holder rising out of the water as it fills with gas, a portion of the oil floating on the water will adhere to the sides of the vessel, and in hot weather will vaporize and go off with the gas. Such films, doubtless, will not be found in gasholders newly filled with water, but they will be found almost to a certainty in gasholders where, as is usually the case, the water has remained unchanged for several years. In these latter cases a hot day will add to the amount of sulphur in the gas as issued to the public, compared with the same gas as it leaves the purifiers. In the case of newly filled gasholders, on the other hand, where the water is fresh, the tendency will be to reduce the amount of impurity in the gas, whether in the form of "sulphur," ammonia, or sulphuretted hydrogen.

Almost every gas engineer who carefully tests the purity of his gas as it leaves the works will have met with instances in which sulphuretted hydrogen has appeared in the gas as it went out of the works, although not a trace of this impurity was discernible at the inlet to the gasholders, and under circumstances where it was known that there had been no mistake in shifting the valves, and no leakage from wear in the valves themselves. As has been strikingly demonstrated by a recent case of impurity in the gas of the Central Company, if "foul" gas (*i.e.*, containing sulphuretted hydrogen) once finds its way into the gasholders, even for a few hours, the impurity is so quickly absorbed by the water in the gasholders as to "foul" the gas for many weeks afterwards. But there is another point to which, although at present they must speak doubtfully, the referees think it advisable to direct attention. It has been ascertained that if gas containing "sulphur" (*i.e.*, sulphur compounds other than sulphuretted hydrogen) be passed through a heated iron tube at a temperature of 500° Fahr., the impurity as a chemical compound will be broken up, depositing carbon, and changing its form into that of sulphuretted hydrogen, so that an acetate of lead test-slip which shows not the slightest stain when held in the gas at the entrance to the heated tube will become perfectly black at the other end. Possibly this chemical change or transmutation of form may take place at a much lower temperature than is at present known, so as to be effected to some extent by the sun's rays on a hot day beating on the thin iron sheets alike of the purifiers and of the gasholders, thereby causing the unexpected appearance of sulphuretted hydrogen—an impurity the least trace of which in the gas is forbidden by the recent gas Acts, under a heavy penalty.

Apart from the difference in the kinds of coal used—some of which give off in the retorts a larger proportion of sulphur than others, even although the amount of sulphur in each may be alike—the chief causes upon which the development of sulphur compounds in the gas may be dependent are (1) the length of time that the coal remains in the retorts, and (2) the temperature at which the coal is distilled or carbonized. Some isolated experiments have been made upon the former of these points, by drawing off and testing a portion of the gas at intervals during the ordinary period of six hours' charge. The latter point it has hitherto been impossible to ascertain reliably, as no pyrometer could be found to bear so high a heat, but Mr. Siemen's new pyrometer, exhibited at a recent meeting the Royal Society, appears to be of a kind available for such experiments.

Amount of the Sulphur Impurity in the Gas.

Having said this much with respect to the investigations which they are present conducting on the sulphur question, with a view to fix a daily maximum with reference to the varied circumstances of the several gas-works, and also as a means of ascertaining the most efficacious methods of purification, &c., by which the sulphur impurity may be reduced below its present amount, the referees beg to make the following statement, showing the quantity of this impurity in the gas of the companies included under the Act of 1868 at the present time, and also at previous times subsequent to 1860, when penalties were first imposed upon the noxious impurities contained in gas.

As shown by the reports of the testings made by Dr. Letheby at the corporation's testing-place previous to the Act of 1868—and thereafter from the daily testings in the five testing-stations established in conformity with the instructions of the referees under that Act—the amount of sulphur in the gas of the Chartered, the Central, and the City companies has averaged as follows:—

Dr. Letheby's Occasional Testings, 1864-8.

Year.	Central.			City.			Chartered.								
							Curtain Road.			Brick Lane.			Westminster.		
	Max.	Min.	Aver	Max.	Min.	Aver	Max.	Min.	Aver	Mx.	Mn.	Avr	Mx.	Mn.	Avr
1864—5	35·0	16·6	21·9	29·7	14·5	19·4	33·7	14·4	20·1						
1865—6	32·9	14·4	24·1	28·2	14·2	19·6	30·7	13·0	21·2						
1866—7	29·93	14·79	21·39	24·97	7·12	17·23	27·80	10·43	17·77						
1867—8	34·61	7·43	17·44	35·34	9·19	19·06	31·96	8·79	19·57						
1868, Feb. to Aug.	2·09	8·85	14·62	25·11	10·56	17·24	23 90	14·27	19·03						

Gas Examiners Daily Testings, 1869-70.

1869, Aug. to Dec.	37·02	4·01	12·5	26·3	12·3	19·9	27·0	8·9	20·9	33·7	17·4	24·4	36·8	14·7	28 5
1870, six months .	24·9	3·4	12·7	25·1	14·6	19·7	28·3	15·8	22·3	30·1	18·6	25 0	36·7	16·6	29·2

Two explanatory remarks are necessary in connexion with these statistics. Firstly, as regards the improvement that has taken place of late years in the purity of the gas of the Central Company. In the earlier years of the above series, the gas of this company was fouler with sulphur than that of any of the others; and the improvement which has subsequently taken place is owing to the adoption of lime in the purifiers, instead of the oxide of iron employed by the other companies. The works of the Central Company at Bow are in a poor locality, and where also there are numerous chemical and other works, which produce greater nuisances than that which arises from the use of lime in gas-works. But in the works of all the other London gas companies the use of lime as a purifier is inadmissible, owing to the nuisance which it occasions to the neighbourhood when taken out of the purifiers and exposed to the atmosphere. The works of the Imperial Company at Fulham are in a locality more thinly peopled than that around the gas-works at Bow, but the inhabitants belong to a higher and wealthier class; and when the Imperial Company, two years ago, attempted to adopt lime as a purifier in their Fulham works, the complaints made and the indictments threatened compelled the company at once to fall back upon the ordinary purifying process by oxide of iron.

The other remark necessary for a right understanding of the above statistics is, that in 1867 an improvement was made in the Letheby sulphur test, which was used in all the above recorded testings; consequently, at any time subsequent to that improvement, the testings would show a greater amount of sulphur, even when the gas remained of the same purity as before.

The Referees New Sulphur Test.

As it has long been known to experienced gas engineers that the sulphur test hitherto most in use, and best adapted for ordinary testing, is an imperfect

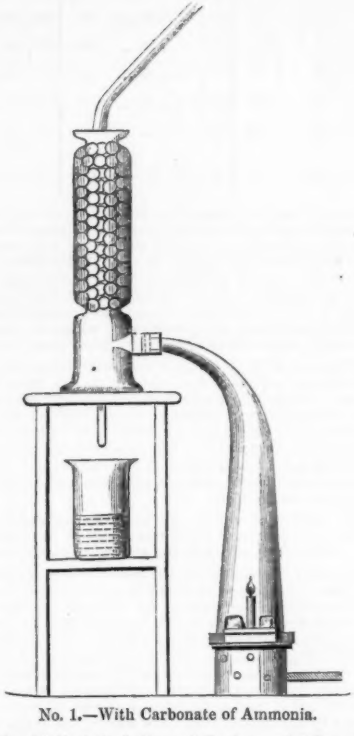
instrument, the referees have endeavoured to obtain a test which, while equally convenient, would more correctly show the amount of this impurity in the gas. They have succeeded in this object; and they have the honour to report that their new sulphur test has now been fitted up in the nine testing-stations established under the London Gas Acts of 1868 and 1869.*

The Letheby sulphur test, hitherto in use, is an instrument similar in form to that originally devised as a condensing apparatus by Sir Humphrey Davy to show the formation of water by the combustion of hydrogen gas—namely, consisting of a trumpet-tube and horizontal cylinder, with an upturned condensing-tube. Within the open lower end of the trumpet-tube is a Leslie burner, in which the gas is consumed; and underneath it a vessel containing liquid ammonia, the vapour from which rises into the trumpet-tube, combining with the sulphurous acid from the gas-flame, and condensing as sulphate and sulphite of ammonia in the cylinder. As it existed in 1860, when the first Act was passed in which penalties for impurity were imposed upon gas companies, the Letheby test (as above mentioned) was inferior in efficiency to the same apparatus as recently improved—the chief improvement being the adoption of a smaller cylinder, alike shorter and narrower.

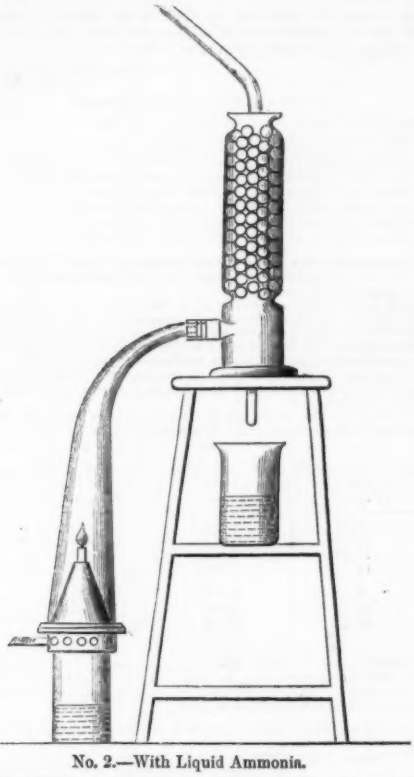
The following diagram represents the new sulphur test, devised by the referees—No. 1 being the form of the instrument adopted in the testing-stations:—

* All of these testing-stations have now been opened, save the one in connexion with the Haggerston works of the Imperial Company, where a house had to be built for the purpose.

THE REFEREES SULPHUR TEST



No. 1.—With Carbonate of Ammonia.



No. 2.—With Liquid Ammonia.

By means of the shield at the bottom of the trumpet-tube, a simple but most efficacious process is adopted for requiating the supply of air to the apparatus, and thereby improving the draught. The common opinion that the draught in a flue or chimney is improved by narrowing the top is subject to serious exceptions; especially in the case of short chimneys, like a trumpet-tube, where the heated air does not cool and contract before passing through the narrowed upper portion of the vent. No doubt, the smoke is seen to move more rapidly through the narrow upper end of the flue than in the wide part below; but this is a most delusive criterion. For example, if the open lower end of a trumpet-tube be ten times larger than the orifice at the top, the air (in order to obtain a perfect draught) must emerge from the tube at a velocity ten times greater than that at which it enters; indeed, still faster, because the air acquires a higher temperature, and hence occupies more space within the tube than it did on entering it. In the Letheby apparatus, the outlet of the trumpet-tube is only one-eighth of the area of the lower end, after deducting from the latter the space occupied by the Leslie burner; and also the temperature of the air within the tube is much hotter, and occupies more space than it did on entering it. Hence the draught is liable to become imperfect. If the visible fumes of chloride of ammonium, or even the smoke of a piece of burning brown paper, be placed so as to enter the lower end of the trumpet-tube, a portion of the fumes or smoke will sometimes be seen to regurgitate and escape at the bottom. In fact, more air is drawn up into the wide lower end of the trumpet-tube by the heat of the burner than can readily pass upward through the narrow aperture at the top; and, in consequence, some of the air occasionally proceeds no further than the flame of the burner, and thereafter descends and escapes at the bottom, carrying with it a portion of the sulphur contained in the gas, which thereby is withdrawn from the test. The fact of the lower end of the Letheby trumpet-tube being open and unshielded also renders the apparatus easily affected by side draughts and currents of air in the room—against which the referees took careful precautions in the fitting up of the apparatus as hitherto employed in the testing stations.

In their apparatus No. 1, the referees use carbonate of ammonia. One of their reasons for doing so is, that carbonate of ammonia vaporizes far more steadily than liquid ammonia, and thereby is more suitable. The result of experiments made by the referees shows that the liquid ammonia of the quantity and strength used in the Letheby test—the same ammonia diluted with one-half its bulk of water—and carbonate of ammonia of the quantity used in the referees test, respectively vaporize—*i. e.*, give off a portion of their substance—as follows, at the temperature of 70°, during the 24 hours which constitute a daily testing of the gas:—

Ammonia, s.g. ·880, 5 ozs. Evaporation.				*Ammonia, ½ strength*, 5 ozs. Evaporation.				*Carbonate of Ammonia*, 1½ oz. Evaporation.			
1st	hour, about		150 grs.	1st	hour, about		48 grs.	1st	hour, about		8·0 grs.
2nd	,,	,,	60 ,,	2nd	,,	,,	30 ,,	2nd	,,	,,	7·75 ,,
3rd	,,	,,	30 ,,	3rd	,,	,,	20 ,,	3rd	,,	,,	7·5 ,,
22nd	,,	,,	7·5 ,,	22nd	,,	,,	7 ,,	22nd	,,	,,	6·5 ,,
23rd	,,	,,	7·0 ,,	23rd	,,	,,	6·5 ,,	23rd	,,	,,	6·4 ,,
24th	,,	,,	6·5 ,,	24th	,,	,,	6 ,,	24th	,,	,,	6·3 ,,

It thus appears that the liquid ammonia of the specific gravity of ·880 evaporates upwards of 20 times faster during the first hour than in the last; whereas the rate of evaporation of the carbonate of ammonia is almost uniform during the whole period of 24 hours. It is needless to add that the carbonic acid given off from the carbonate of ammonia is too infinitesimal in quantity to affect the combustion of the gas.

The referees have also arranged their sulphur test so that it can be used with liquid ammonia. In this case (*vide* fig. 2 of the diagram), a cone is fitted in the bottom of the trumpet-tube, its base covering the top of the beaker containing the liquid ammonia, and its open upper end rising to within an inch of the top of the Bunsen burner—a burner in which a portion of the ammonia vapour enters and mingles with the gas, and accordingly is burnt along with it. By altering the size of the upper orifice of the cone, liquid ammonia of various strengths can be used, more air being wanted for strong ammonia than for weak. As the result of their experiments, the referees find that with the strong ammonia used in the Letheby apparatus—viz., specific gravity ·880—the orifice of the cone should have a diameter of about three-quarters of an inch; for ammonia diluted with one-half of water, an orifice of five-eighths of an inch gives the best results.

The following table gives the results of a series of experiments made with the referees instruments compared with the Letheby test:—

	REFEREES SULPHUR TEST.			LETHEBY SULPHUR TEST.
	Strong Ammonia (·880), with ¾-inch Cone.	Ammonia, half strength, with ¾-inch Cone.	Carbonate of Ammonia, with Shield.	
	Per 100 Feet of Gas. Grains.	Per 100 Feet of Gas. Grains.	Per 100 Feet of Gas. Grains.	Per 100 Feet of Gas. Grains.
Gas of Chartered Company.	30·05	33·04	..	22·2
	29·05	31·7	35·4	25·1
	32·6	..	..	21·0
	..	32·9	35·5	24·4
	..	..	32·6	22·2
	..	30·8	35·1	—
	29·2	30·09	32·2	—
	..	30·8	35·0	—
	..	29·6	30·1	—
	28·08	28·59	32·3	—
	..	..	31·8	23·8
	..	29·8	33·1	—
	..	..	29·2	23·9
	..	..	29·6	24·9
	..	..	31·17	24·9
	..	..	31·4	25·4
	..	..	32·27	25·8
	..	..	32·08	25·24
	..	..	31·6	24·32
	..	..	32·96	23·96
	..	..	34·17	—
	..	..	34·41	23·35
	..	..	35·0	21·86
	..	..	34·73	24·92
	..	..	34·98	25·82
	..	..	34·8	25·24
	..	..	35·5	25·4
	..	..	36·26	25·12
Gas of Equitable Co.	24·5	24·65	25·2	—
	23·8	26·1	27·8	—
	..	23·7	27·4	—
	..	23·9	26·85	—
	..	25·9	27·4	18·4
	..	24·1	28·0	19·2
	..	24·6	27·7	23·3
	..	..	26·6	20·6
	..	..	28·03	20·4
	Average, 28·1 grs.	28·1 grs.	31·6 grs.	23·1 grs.

This table, when summarized, shows that the referees sulphur tests give the following results compared with the Letheby apparatus:—

Letheby Test.—Liquid Ammonia, s.g. ·880, detects . . . 23·1 gr. sulph.
Referees Test.— Do., do., with ¾-inch cone . . 28·1 „
Referees Test.— Do., with ½ water, and ½-inch cone . . 28·1 „
Referees Standard Test.—Carbonate of Ammonia, with shield 31·6 „

In order to simplify the calculations, and thereby lessen the work of the gas examiners, the referees, in conjunction with their new sulphur-test, have introduced a stop-meter, by which exactly 10 feet of gas are operated upon in each testing. By means of this apparatus the calculations are simplified to the fullest possible extent, and the mere shifting of the decimal point gives the number of grains of sulphur per 100 feet of gas. By this means also, the apparatus being self-acting, six testings during the week can be made instead of five as at present.

Although thoroughly satisfied by their own numerous experiments, the referees, for the full satisfaction of all parties, have submitted their sulphur test to Dr. Odling, who reports upon it as follows:—

Royal Institution, Albemarle Street, W. July 13, 1870.

To the Gas Referees of the Metropolis.

Gentlemen,—I have made an examination of the process introduced by you for estimating the quantity of sulphur present in coal gas.

The process consists substantially in burning the gas from a small steatite Bunsen burner, at the rate of about half a cubic foot an hour. The burner is mounted on a pewter foot, in form of a short cylindrical box, perforated with holes for the admission of air, and having on its upper surface a deep circular channel to receive the wide end of a glass trumpet-tube, carrying off the combustion products into a condenser. The space on the top of the pewter box, between the narrow stem of the burner and the surrounding glass trumpet, has to be packed with pieces of commercial sesquicarbonate of ammonia.

By these arrangements the flame is very perfectly protected from draughts, and the products of its burning are formed in presence of a uniformly sufficient, but not at any time excessive, quantity of ammonia.

The products, both of the combustion of the gas and of the gradual volatilization of the ammonia salt, go upwards through the trumpet into a vertical glass condenser, packed with balls of glass, to break up the current and promote condensation. From the top of the condenser there proceeds a long glass pipe or chimney, serving to effect some further condensation, as well as to produce a draught and afford an exit for the uncondensable gases. From the bottom of the condenser there proceeds a small glass tube, serving as an exit for the condensed liquid, the sulphate contained in which is estimated in the usual manner.

1. I find that the results of simultaneous experiments made by your method are closely concordant with one another, as shown in the following table:—

No. of Experiment.	Cubic Feet of Gas burned in 24 Hours.	Grains of Sulphur per 100 Cubic Feet of Gas.	Cubic Feet of Gas burned in 24 Hours.	Grains of Sulphur per 100 Cubic Feet of Gas.
1	11·92	26·64	11·93	26·41
2	10·58	25·76	9·86	25·60
3	10·55	21·04	10·06	21·67
4	12·79	21·33	11·59	21·38
5	9·57	21·29	10·24 10·56	21·30 21·19
6	16·27	23·67	10·65	22·13
7	16·43	28·56	11·05	28·00

It will be observed that, except in the sixth experiment, the results of simultaneous determinations are exceedingly close, far more close than those yielded by the ordinary mode of experimenting. The discordance of results afforded by the sixth experiment was probably due to some oversight or accident.

2. The results furnished by your new method are considerably in excess of those furnished by Dr. Letheby's well-known method, as shown in the following table of the results of simultaneous experiments made with your apparatus and that of Dr. Letheby:

Experiment.	Grains of Sulphur per 100 Cubic Feet of Gas. Dr. Letheby's Apparatus.	Referees Apparatus.
A	21·04	26·41
B	19·32	25·60
C	19·76	21·33
D	17·48	21·04

Altogether, I find your process extremely easy of performance, while it is certainly more trustworthy and accurate than any other process hitherto contrived for the use of practical men. In particular, I consider the substitution of solid sesquicarbonate of ammonia for the solution of ammonia hitherto used as a very valuable improvement in the process.

For convenience of calculation in your testing-stations, you at present burn the gas in your apparatus at the rate of 10 feet in 20 hours. I believe, however, that you would get higher, and therefore still better results by burning the gas at a somewhat more rapid rate.

William Odling, M.B., F.R.S.

Before concluding this section of their report, the referees beg to call attention to the greatly increased stringency of the test which they have prescribed for sulphuretted hydrogen. The test as imposed by the Act of 1860 was to hold a test-slip in the gas for one minute. By the mode of testing prescribed by the referees, the test-slip is suspended in the gas for several hours continuously, and as sulphuretted hydrogen acts with cumulative effect on the acetate of lead test-paper, the gas companies have now to bestow much greater care than before on their processes for ridding their gas of this noxious impurity. The Central Company, with this object, have recently added to their works an additional purifier, placed beyond their gasholders, in order that the contents of any gasholder which unexpectedly becomes "foul" may be cleared of the impurity before issuing to the public. A similar precaution against unexpected impurity is being taken at the new works of the Chartered Company at Beckton, and the referees consider that it should be adopted in every gas-work where it is possible to do so.

The referees may add, that the mode of preserving the test-slips as evidences of impurity recently recommended as the best has been to place them in glass bottles with air-tight stoppers. But the referees were aware that this was an inadequate precaution, inasmuch as the stains on the test-slips produced by sulphuretted hydrogen become bleached and disappear when sunlight falls upon them. And as a week must usually intervene between the occurrence of a penalty and the investigation consequent upon an appeal on the part of a gas company, there is a risk (if the slips be kept in glass bottles) that the evidence of the impurity may disappear in the interval. The following was one of the experiments made by the referees on this point:—A piece of test-paper, equally stained throughout with sulphuretted hydrogen, was cut into four parts. Two of these were placed in a book, like that supplied to the gas examiners for recording the results of the testings; another was suspended in an opaque tube, through which the air of the room was made to pass in a steady current; the fourth was placed in a glass bottle with air-tight stopper exposed to the sunlight, both the opaque tube and the bottle being placed together in the window. The result was that the test-slip in the opaque tube, as well as the two others in the book, remained unchanged, whereas the stain on the slip kept in the air-tight stoppered bottle quickly lost its colour; in other words, in the latter case, the evidence of a penalty having been incurred quickly disappeared, whereas in the former it was fully preserved.

On Fixing a Maximum for the Sulphur Impurity.

In the Act of 1860, which prescribed a sulphur maximum of 20 grains per 100 feet of gas, legislation took "a leap in the dark," the real quantity of sulphur existing in the gas being then unknown, and the causes of its presence in the gas being most imperfectly understood. Indeed, as the evidence given before the parliamentary committee of that year shows, it was believed that this impurity in the gas was owing *solely* to the companies distilling the gas in their retorts at an excessive temperature, an opinion now abandoned as erroneous. The gas companies found it so impossible to comply with the maximum fixed in 1860 that this penal clause of the Act fell into total abeyance. It appears from Dr. Letheby's reports to the corporation that the number of times that the maximum was exceeded during the years immediately preceding the passing of Act of 1868 was as follows:—

Year.	Chartered.			City.			Central.		
	Number of Testings.	Number of Times in Excess of 20 Grains.	No. of Times in Excess per Annum.	Number of Testings.	Number of Times in Excess of 20 Grains.	No. of Times in Excess per Annum.	Number of Testings.	Number of Times in Excess of 20 Grains.	No. of Times in Excess per Annum.
1864–5	280	139 or 50 p. c.	181	280	93 or 33 p. c.	121	280	226 or 81 p. c.	294
1865–6	224	126 „ 56 „	205	220	87 „ 39 „	144	220	212 „ 96 „	352
1866–7	240	69 „ 29 „	105	228	80 „ 35 „	128	230	169 „ 73 „	268
1867–8	219	92 „ 42 „	153	222	100 „ 45 „	164	220	71 „ 32 „	118
Feb. to Aug., 1868	61	24 „ 39 „	143	58	10 „ 17 „	63	60	9 „ 15 „	55
	Average, 43 p. c.		157	Average, 34 p. c.		124	Average, 59 p. c.		217

From these recorded facts it appears that, on the average of those years, the gas of the Chartered Company showed an excess of sulphur 43 times in every 100 experiments; the City Company's gas, 34 times; and the Central Company's gas, 59 times. In other words, if testings had been made daily, the Chartered Company, for its single station at Curtain Road, would have been liable to penalty 157 times in the year; the City Company, 124 times; and the Central Company, 217 times! And had the gas during those years been tested throughout by a more perfect apparatus, the penalties to which the companies would have been liable would, of course, have been still more numerous.

In considering the Act of 1868, the parliamentary committee of that year found that no satisfactory evidence upon this point had been adduced before them, or before any of the previous parliamentary committees; and accordingly they referred this question, among others, to be determined after due investigation by the referees, from time to time, with the view of reducing the sulphur impurity to the lowest possible amount; the circumstances of each gas-work to be taken into account, and a reasonable time to be allowed to each company to make such alterations and improvements in their gas-works as may be requisite under the certificate of the referees.

Not only was the amount of sulphur in the gas underrated in 1860, but the main obstacle to fixing a daily maximum was then wholly unknown or unappreciated—viz., the daily fluctuations in the amount of this impurity.

As was known to their late colleague, Mr. Evans, whose eminence and great experience as a gas engineer are universally acknowledged, and as was evidenced by the records of the daily testings for sulphur kept at his works, and at some others, which were freely given to the inspection of the referees, one of the most striking and serious difficulties connected with the sulphur question, and especially with fixing a legal maximum for that impurity, consists in the extraordinary fluctuations from day to day in the amount of sulphur in the gas. It was impossible that these most embarrassing fluctuations could be adequately known in 1860, or indeed at any period until a system of *continuous daily testings* was established by the Act of 1868. No notice was taken of them as an element of difficulty in fixing a daily maximum, either in 1860 or in the evidence adduced before any of the subsequent parliamentary committees of 1866-7-8. As the testings for the corporation upon the gas of any particular company were not made continuously, but only from time to time, the difference between the maximum and minimum of sulphur, shown in the reports of Dr. Letheby, might be regarded (and apparently were regarded) as due not to mere fluctuations, but to actual changes in the kind of coal used, or in the processes of distillation and purification. But the continuous daily testings now established show clearly that, with the same kind of coal and processes of distillation and purification, the fluctuations in the amount of sulphur in the gas are as serious in extent as they are as yet unexplained, and unaccountable save from the serious and unsuspected defects in the purifying processes which the experiments of the referees are now bringing to light. As shown by the records of the daily testings, the fluctuations in question are continuous throughout the year. The extent of those fluctuations will be clearly seen in the following table, which gives the results of the daily testings made in the official testing-stations during the last six months:—

Results of the Testings for Sulphur, Jan. 1 *to June* 30, 1870.

(Letheby Apparatus.)

	Chartered Company.			City Company.	Central Company.
	Arundel Street.	Leadenhall Street.	Gray's Inn Road.	Cannon Street.	Friendly Place.
1870.					
Jan. 1	36·5	No test.	25·9	18·6	5·56
„ 3	..	25·5	26·8	19·8	18·7
„ 4	33·8	..	..	..	—
„ 5	32·6	23·2	22·1	19·6	10·1
„ 6	35·1	23·5	25·0	20·7	6·82
„ 7	27·1	21·2	26·0	17·9	11·3
„ 8	26·7	Experimt. lost	24·9	20·1	18·2
„ 10	..	23·7	23·1	20·1	17·4
„ 11	27·7	..	..	..	—
„ 12	30·1	Experimt. lost	20·6	21·8	16·1
„ 13	30·5	16·0	23·5	20·1	12·1
„ 14	28·6	15·8	23·3	21·6	15·9
„ 15	33·0	18·4	22·8	18·9	24·5
„ 17	..	No test.	24·7	18·8	24·5
„ 18	29·4	„ „	..	..	—
„ 19	30·8	„ „	23·4	18·2	20·9
„ 20	30·1	Water in pipes	21·8	18·9	17·7
„ 21	30·5	21·6	22·1	18·4	17·8
„ 22	35·8	22·5	23·6	21·1	24·9
„ 24	..	20·8	21·4	23·2	14·6
„ 25	33·1	Certif. susp.	Certif. susp.	Certif. susp.	—
„ 26	32·5	..	..	..	13·9
„ 27	30·5	..	..	..	11·5
„ 28	29·5	..	..	..	Certif. susp.
„ 29	30·0	..	..	..	..
„ 31	..	..	..	..	..
Maximum.	36·5	25·5	26·8	23·2	24·9
Minimum.	26·7	15·8	20·6	17·9	5·5
Average .	31·1	21·1	23·5	19·8	15·9

	Chartered Company.			City Company.	Central Company.
	Arundel Street.	Leadenhall Street.	Gray's Inn Road.	Cannon Street.	Friendly Place.
Feb. 1	35·0	Certif. susp.	Certif. susp.	Certif. susp.	Certif. susp.
„ 2	34·3	..	..	..	..
„ 3	33·1	..	..	..	..
„ 4	33·8	..	..	..	..
„ 5	34·7	..	..	..	..
„ 7	..	..	..	..	..
„ 8	32·0	..	..	..	..
„ 9	29·0	..	..	..	..
„ 10	27·0	..	..	..	..
„ 11	24·5	19·2	24·8	19·7	18·9
„ 12	28·4	19·8	20·5	19·6	14·2
„ 14	..	21·1	20·0	20·8	17·0
„ 15	28·4	..	..	..	—
„ 16	29·2	22·5	18·7	17·8	15·9
„ 17	28·2	24·1	18·6	19·0	22·6
„ 18	27·0	22·2	Leakage	18·4	15·1
„ 19	27·1	23·0	..	17·6	15·2
„ 21	..	22·8	..	18·0	22·6
„ 22	29·2	..	..	..	—
„ 23	29·9	24·5	26·7	16·1	13·18
„ 24	30·5	22·9	26·5	16·1	5·28
„ 25	30·5	24·8	27·7	18·3	9·8
„ 26	29·4	23·3	27·2	20·8	14·5
„ 28	..	Experimt. lost	28·6	20·7	10·2
Maximum.	35·0	24·8	28·6	20·8	22·6
Minimum .	24·5	19·2	18·6	16·1	5·2
Average .	30·0	22·6	23·9	18·8	14·8
March 1	24·7	..	..	..	—
„ 2	27·7	28·3	24·7	20·6	21·4
„ 3	Certif. susp.	24·6	30·1	21·1	12·06
„ 4	..	26·7	29·2	20·8	11·05
„ 5	..	19·0	27·8	19·7	12·06
„ 7	..	22·5	27·2	18·4	8·0
„ 8	..	..	..	..	—
„ 9	..	22·3	26·7	21·2	8·47
„ 10	..	22·9	26·5	21·5	8·84
„ 11	..	23·3	25·9	22·4	10·74
„ 12	..	27·0	Expt. spoilt	21·3	11·8
„ 14	..	24·3	27·7	21·0	10·0
„ 16	..	..	..	..	—
„ 17	..	23·3	27·9	21·9	11·9
„ 18	..	26·3	27·7	25·1	13·4
„ 19	31·0	25·8	27·0	20·0	12·9
„ 21	..	25·1	27·6	22·6	10·9
„ 22	26·2	..	..	..	—
„ 23	25·3	21·7	25·0	19·6	13·2
„ 24	25·0	22·2	25·9	20·7	17·9
„ 25	No test	24·2	26·0	24·0	11·5
„ 26	23·8	23·7	24·6	23·6	3·4
„ 28	..	22·6	19·9	22·2	8·7
„ 29	28·1	..	..	..	—
„ 30	16·6	18·2	19·8	20·6	7·8
„ 31	27·5	23·6	23·5	22·5	9·6
Maximum	31·0	28·3	30·1	25·1	21·4
Minimum	16·6	18·2	19·8	18·4	3·4
Average .	25·4	23·7	26·0	21·4	11·2
1870.					
April 1	29·7	24·6	27·9	25·0	10·7
„ 2	23·5	24·2	26·1	22·0	8·3
„ 4	..	24·0	26·8	18·6	8·5
„ 5	24·5	..	..	..	—
„ 6	27·0	20·6	23·5	14·6	11·3
„ 7	27·0	20·8	23·9	18·8	13·4
„ 8	..	24·2	24·1	21·2	14·8
„ 9	32·4	23·6	26·8	19·9	11·4
„ 11	..	No test	27·4	18·2	9·7
„ 12	22·9	..	..	..	—
„ 13	25·2	25·1	27·7	16·8	12·1
„ 14	28·2	26·7	26·4	19·3	14·9
„ 18	..	26·9	28·9	19·4	13·7
„ 19	26·9	..	..	..	—
„ 20	26·7	Water in pipes	26·8	17·8	18·3
„ 21	25·4	25·1	30·2	18·8	18·6
„ 22	31·0	21·4	29·5	19·1	12·2
„ 23	27·1	Water in pipes	29·6	19·0	10·3
„ 25	..	„ „	28·3	19·6	11·1
„ 26	No test	..	..	..	—
„ 27	..	17·2	25·4	20·3	12·6
„ 28	..	18·6	24·8	17·9	8·9
„ 29	..	19·7	22·9	15·5	9·8
Maximum	32·4	26·9	30·2	25·0	18·6
Minimum	22·9	20·6	22·9	14·6	8·3
Average .	26·9	22·8	26·7	19·0	12·1
May 2	..	22·1	Gas out.	21·7	12·2
„ 3	27·0	..	..	..	—
„ 4	30·6	20·9	23·5	18·5	11·3
„ 5	31·8	23·3	24·1	20·9	10·0
„ 6	30·7	24·3	24·8	20·0	13·2
„ 7	32·5	25·8	26·3	19·3	11·9
„ 9	..	25·2	26·6	19·9	8·7
„ 10	27·1	..	..	..	—
„ 11	30·3	23·7	24·7	20·9	7·8
„ 12	32·2	Experimt. lost.	25·6	23·2	10·8
„ 13	31·0	„ „	26·5	23·5	10·2
„ 14	32·5	25·9	26·9	23·2	11·0
„ 16	..	24·5	23·8	22·4	8·9
„ 17	28·0	..	..	..	—
„ 18	30·8	22·8	26·3	21·4	8·6
„ 19	36·7	24·9	25·6	20·9	8·9
„ 20	33·7	25·1	26·6	21·3	8·8
„ 21	36·3	24·0	25·6	22·5	7·9
„ 23	..	17·5	25·4	20·4	8·4
„ 24	33·6	..	..	..	—
„ 25	33·7	23·1	22·3	17·8	5·5
„ 26	33·8	20·3	23·7	19·3	6·8
„ 27	31·3	21·9	23·2	19·3	7·2
„ 28	32·4	22·7	23·9	17·6	7·2
„ 30	27·9	..	25·2	18·9	8·6
„ 31	27·9	..	..	..	—
Maximum.	36·7	25·9	26·9	23·5	13·2
Minimum .	27·0	17·5	22·3	17·6	5·5
Average .	31·7	23·2	25·0	20·8	9·3
June 1	33·0	23·3	24·5	..	9·5
„ 2	33·2	23·06	25·5	16·4	10·4
„ 3	34·6	23·6	24·8	18·6	10·1
„ 4	31·3	23·8	24·9	18·2	8·3
„ 6	..	22·3	22·5	17·3	6·7
„ 7	31·5	..	..	..	—
„ 8	32·3	21·0	24·9	17·8	4·0
„ 9	29·0	20·7	24·3	18·0	7·5
„ 10	..	21·4	25·1	18·0	8·8
„ 11	..	20·3	24·3	..	11·5
„ 13	..	21·3	24·3	15·8	12·1
„ 14	33·4	..	..	..	—
„ 15	28·5	18·8	25·7	19·0	20·5
„ 16	30·0	19·7	25·9	19·7	12·8
„ 17	..	18·9	26·7	19·6	14·2
„ 18	31·0	17·4	26·8	19·6	16·9
„ 20	..	17·4	26·0	19·8	20·9
„ 21	18·9	..	..	..	—
„ 22	31·4	18·7	26·1	20·1	15·2
„ 23	30·8	18·6	25·3	19·6	20·0
„ 24	30·7	21·2	26·7	20·7	17·8
„ 25	28·1	18·5	26·1	20·1	15·5
„ 27	..	20·3	24·3	18·9	21·3
„ 28	27·7	..	..	..	—
„ 29	..	19·1	25·6	19·0	19·7
„ 30	..	20·0	25·3	19·7	10·3
Maximum.	34·6	23·8	26·8	20·7	21·3
Minimum .	18·9	17·4	22·5	15·8	4·0
Average .	30·3	20·4	25·2	18·8	13·3

It will be observed from these returns that the gas of the City Company shows a far less degree of fluctuation in its sulphur quality than that of the two other companies. There is no peculiarity in the "purifying" processes adopted in the works of the City Company, and the engineer, Mr. Mann, is unable to explain how it is that the amount of this impurity in his gas is comparatively so steady. There appears, however, good reason to believe that, as this is obviously not due to chemical science or appliances, the explanation is to be found in the great care bestowed in those works upon the mechanical details of gas manufacture, and the comparative perfection to which they have been brought. This is a most important matter, and it will be duly investigated.

In regard to the Imperial and South Metropolitan Companies, included under the Gas Act of 1869, the opening of the new testing-stations will now show the amount of sulphur in the gas from the several works of those companies, as well as the extent of the daily fluctuations.

The effect of the daily fluctuations as an element of difficulty in fixing a sulphur maximum for the various gas-works will readily be understood; but to show it more clearly, the following excerpts are given from the testings of gas of the Central Company, where the most efficient mode of sulphur purification yet known (namely, by lime) is in use:—

Daily Fluctuations in the Amount of Sulphur in the Gas.

Jan.	1, 1870	. . . .	5·56	April	21, 1870	. . . .	18·6
„	2, „	. . . .	18·7	„	22, „	. . . .	12·2
„	22, „	. . . .	24·9	„	23, „	. . . .	10·3
„	23, „	. . . .	14·6				
				May	5, „	. . . .	13·2
Feb.	21, „	. . . .	22·6	„	6, „	. . . .	11·9
„	23, „	. . . .	13·1	„	7, „	. . . .	8·7
„	24, „	. . . .	5·28				
				June	10, „	. . . .	8·8
March	23, „	. . . .	13·2	„	11, „	. . . .	11·5
„	24, „	. . . .	17·9	„	13, „	. . . .	12·1
„	25, „	. . . .	11·5	„	15, „	. . . .	20·5
„	26, „	. . . .	3·4	„	16, „	. . . .	12·8

Here, it appears, that although the average amount of sulphur is much below that of the other companies (none of which at present are permitted to use lime), the fluctuations are so constant that, if the maximum were fixed by an average, the company would be liable every other day to a penalty of £50. Mr. Harris, the engineer of the Central Company, who has given the most careful attention to this form of sulphur purification, states that the above-shown fluctuations are as yet entirely beyond his control; and the referees have satisfied themselves that this is truly the case. At the same time it must be said that the results of the various experiments of the referees now in progress already show that, in the processes of sulphur purification generally, an absence of knowledge prevails to a serious extent, and which may easily be remedied, especially now that the efforts and abilities of the gas engineers of the companies can be combined and systematically directed under the instructions of the referees, with whom (the referees have much pleasure in saying) these gentlemen most cordially co-operate; and it is needless to add that such co-operation, laborious as it is to the engineers and more or less costly to the companies, is of great service in the interests of the gas consumers.

The investigations of the referees—alike tentatively in the laboratory, and also in the practical and only reliable form of experiments on a manufacturing scale in the gas-works—with a view to reduce the amount of the sulphur impurity, are being systematically carried on. Those investigations of themselves tend to reduce the amount of this impurity, by throwing new light upon, and giving unexpected results from, each part of the series of processes in use for purifying the gas from sulphur. Summarily to fix a maximum while those investigations are still in progress would result either in fixing it so high (on account of the daily fluctuations as yet beyond control) as to render it worthless; or in repeating the error of 1860 (expressly avoided by the Acts of 1868-9) by fixing the maximum at a point which the companies cannot at present comply with, and for the steady observance of which no means are as yet known, thereby rendering penalties for this impurity (£50 for each transgression of the maximum) practically uninflictable, because contrary to common justice and equity. But at the earliest moment when the initial obstacles are removed, the referees will prescribe the amount of sulphur to be temporarily allowed in the gas supplied from the several gas-works; and they will thereafter reduce the amount of this noxious impurity from time to time, in proportion as their own investigations or the discoveries of others may enable them to do so. In so fixing a maximum, the referees, as enjoined by the Acts of 1868-9, will take into account the circumstances of the several gas-works, fixing a lower maximum for gas-works which have a wider scope than others for the adoption of purifying processes; as the Central Company has at present by the use of lime, and as the Chartered Company will soon have, to a still greater degree, in their new and extensive works soon to be opened at Beckton.

T. Foster, Secretary.

DEATH OF SIR JOHN THWAITES.—We regret to announce the death of Sir John Thwaites, the chairman of the Metropolitan Board of Works, which occurred on Monday morning, the 8th inst., at about three o'clock, at his residence, Meaburn House, Upper Richmond Road, Putney, after an illness of a few days duration. Sir John Thwaites was in his 56th year, and had been chairman of the Metropolitan Board since its formation in 1856, previously to which time he was one of the Metropolitan Commissioners of Sewers. Sir John was a magistrate of the counties of Surrey and Middlesex, and a deputy-lieutenant of the latter county.

TERMINATION OF THE DISPUTE AT THE THORNCLIFFE COLLERIES.—On Thursday afternoon, Mr. W. S. Stanhope, accompanied by a deputation of the late workmen, waited on Messrs. Newton, Chambers, and Co., at the offices, and, after a discussion lasting nearly three hours, terms were agreed upon, drawn up and signed by Mr. Stanhope. It was stipulated that the men should make application for work individually, and the firm engaged to employ the old hands, where they could, in preference to new ones. It was also agreed that 21 cwt. should be given to the ton, and that there should be fortnightly reductions in what are termed headings, and also in yard work, was also submitted to by the men. Messrs. Newton, Chambers, and Co. undertook that 320 of the old hands (out of 800) should be employed within a month from terms being accepted. The agreement entered into was to be submitted to the men for their approval on Friday, so that the dispute which has now lasted for seventeen months, and cost the Miners Association upwards of £27,000, is now brought to a termination, and without any material gain to the men.

HARD *v.* SOFT WATER.—Mr. Bateman, C.E., has addressed some remarks to the Manchester Town Council on the prejudice existing to soft water as causing the great mortality existing in many of the large towns and cities in the kingdom, which are of general interest. He says there is no truth in the prejudice, and that the facts which were relied upon would not bear the test of scrutiny. A table had been appended to the evidence taken before a parliamentary committee on the East London Water Bill of 1867, which purported to give the mortality of various towns and places, distinguishing between those supplied with water above and below 10° of hardness, but this division does not correctly represent the point of separation. The term "hard" is applied to water which breaks or curdles soap, and the term "soft" to water which does not do so. Water of 4° of hardness does not break soap, while water of 5° does. Water of 10° is, therefore, hard water. The table referred to contains the names of 16 places supplied with water of 10° or upwards, and of 11 towns in which the water does not amount to 10°. The general conclusion is, that in towns with water over 10° (the average being 14·9) the mortality is only 22·2 per 1000 of the population, while in those having water under 10° (the average being 4·9) the mortality is 26·1, and that in London, the water being 13° of hardness, the mortality per 1000 is 23·1. To say nothing of the unfairness of comparing such towns as Leamington, Southport, Croydon, and Cheltenham with Liverpool, Sheffield, Glasgow, and Manchester, the table is full of inaccuracies. Guildford is represented to contain 29,330 persons. The mortality is 19·4; while its population is really under 10,000, and in a remarkably healthy position. Newcastle and Gateshead are put down as containing 14,646, and the mortality is 19 per 1000; while the real population of those places at the date spoken of was 163,807, and the mortality 27·37. The gross population of the 16 places named is, according to the table, 1,135,514, and that of the 11 places, 1,532,784. The density of population which is not shown in the table is in the former group 10·17 persons to the acre, and in the latter 21·474 to the acre, so that in the town of higher mortality the people are living twice as thick upon the ground as in the place with which they are compared. The density of population exercises an important bearing upon the mortality, especially on the health of infants under five years. Deduct the deaths of such infants, and the mortality per 1000 is 13·56 in the 16 places supplied with water of 10° or upwards, and 13·47 per 1000 in those having softer water. But the strongest proof that the excessive mortality must be sought for in other causes than the hard or soft character of the water will be seen by an examination of the mortality which obtains in different places supplied with the same water. For instance, Birmingham is made up of that town and King's Norton and Ashton, the density of population being respectively 100, 1·37, and 2·7 persons to the acre, and the mortality respectively 26·5 per 1000, 17·1, and 21 per 1000. If the high death-rate in Manchester was due to the soft water, why did it not poison as many persons per 1000 in Chorlton-upon-Medlock as in Salford? The fact is that neither hard water nor soft water appears to exercise any perceptible influence on the tables of mortality. Both are apparently equally wholesome as far as the death-rate is concerned, though many painful diseases which are not fatal are with reason believed to be aggravated by the use of hard water. While it is most conclusively shown that soft water is not injurious to health, the economic benefits which attend its use are so striking and so great, that happy indeed those people may consider themselves who have the advantage of such deliciously pure and soft water as the water-works of Glasgow and Manchester afford.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2158.—DANIEL NATHAN DEFRIES, of Euston Road, in the co. of Middlesex, gas engineer, for "*An improvement in the manufacture of gas-meters.*" Aug. 2, 1870.

2176.—THOMAS BARLING, of the Royal Baths, Weymouth, in the co. of Dorset, for "*Improvements in burners for burning gas and volatile combustible liquids.*" Aug. 4, 1870.

2177.—JOAQUIM ANTONIO DE MACEDO, of Burton House, Leeds, in the co. of York, for "*Improvements in obtaining motive power from a fall of water.*" Aug. 4, 1870.

2200.—JAMES GARTH MARSHALL, of Holbeck, Leeds, in the co. of York, flax spinner, for "*Improvements in ventilation and in the purification of air.*" Aug. 8, 1870.

2217.—GEORGE HUNTRISS, colliery manager, JOHN SWINBURN, engineer, and JAMES WILSON, colliery viewer, all of Barnsley, in the co. of York, for "*Improvements in means or apparatus for supplying mines and other places with lighting gas.*" Aug. 10, 1870.

2224.—NICHOLAS DEMETRIUS SPARTALI, of Liverpool, in the co. of Lancaster, steam-ship agent, for "*Improvements in apparatus for compressing air and raising and forcing fluids.*" Aug. 10, 1870.

2228.—EDMUND WILLIAM PYLE TAUNTON, of Birmingham, in the co. of Warwick, manufacturer, for "*Improvements in pumps for raising and forcing liquids.*" A communication. Aug. 11, 1870.

2229.—THOMAS PENN, of 40, Westbury Street, Wandsworth Road, Clapham, in the co. of Surrey, for "*An improved method of regulating the opening and closing of water-closet and other cocks by hydraulic pressure.*" Aug. 11, 1870.

GRANTS OF PROVISIONAL PROTECTION.

2041.—HENRY REDFERN, of the town and co. of the town of Nottingham, manufacturer of ball-valves, for "*Improvements in the manufacture of ball-valves for supplying water-cisterns and tanks.*" July 20, 1870.

2057.—THOMAS ALFRED WARRINGTON, of 8, Duke Street, Adelphi, in the co. of Middlesex, civil and mechanical engineer, for "*Improvements in ventilators.*" July 21, 1870.

2063.—JABEZ JOSEPH MARRIOTT SILLS, of the town and co. of the town of Nottingham, tin, iron, and zinc plate worker and portable closet manufacturer, for "*An improved combined portable water-closet, night commode, and chamber pail.*" July 21, 1870.

2071.—THOMAS HIGGS and JOHN ELLIOTT, of Holborn, in the co. of Middlesex, for "*Improvements in gas-regulators.*" July 22, 1870.

2075.—RICHARD BAILEY, of Barrow-in-Furness, in the co. of Lancaster, schoolmaster, for "*Improvements in ventilating and heating rooms and other places, and apparatus therefor.*" July 23, 1870.

2081.—HENRY DOULTON, of High Street, Lambeth, in the co. of Surrey, for "*Improvements in stop-valves.*" July 23, 1870.

2083.—WILLIAM EDWARD NEWTON, of 66, Chancery Lane, in the co. of Middlesex, civil engineer, for "*Improvements in apparatus for the manufacture of gas.*" A communication. July 23, 1870.

2117.—ANTHONY GAPPER SOUTHBY, of 3, New Inn, Strand, London, for "*Improvements in apparatus for cooking by gas.*" July 28, 1870.

2120.—ROBERT BOYLE, of Glasgow, in the co. of Lanark, N.B., artist, for "*Improvements in ventilators.*" July 28, 1870.

2158.—DANIEL NATHAN DEFRIES, of Euston Road, in the co. of Middlesex, gas engineer, for "*An improvement in the manufacture of gas-meters.*" Aug. 2, 1870.

2176.—THOMAS BARLING, of the Royal Baths, Weymouth, in the co. of Dorset, for "*Improvements in burners for burning gas and volatile combustible liquids.*" Aug. 4, 1870.

NOTICES TO PROCEED.

978.—HENRY JAMES TAYLOR PIERCY, of Birmingham, in the co. of Warwick, machinist, for "*Improvements in tube-cutters and screw-stocks.*" April 2, 1870.

1014.—WILLIAM YOUNG, manager of the Chemical Works, Magdalen Bridge, in the co. of Mid Lothian, and PETER BRASH, of Leith, in the same co., soap, candle, and oil manufacturer, for "*Improvements in the manufacture of illuminating gas.*" April 6, 1870.

1064.—CHARLES CLEMENT WALKER and WILLIAM THOMAS WALKER, of Midland Iron-Works, Donnington, near Newport, Shropshire, engineers, for "*Improvements in centre-valves for gas-purifiers and other apparatus.*" April 12, 1870.

1382.—HENRY ORMSON, of Stanley Bridge, Chelsea, in the co. of Middlesex, horticultural builder and hot water apparatus manufacturer, for "*Improvements in warming and ventilating horticultural buildings and other structures.*" May 14, 1870.

1849.—SAMUEL NORTON, of the firm of Norton and Co., of Stockport, in the co. of Chester, patentees manufacturers, for "*An improved and combined hydraulic filter and double valve-tap.*" June 29, 1870.

2024.—WILLIAM SLEIGHT BENTLEY, gas-fitter, and WILLIAM ISHAM, mechanic, both of Boston, in the co. of Lincoln, for "*Improvements in apparatus for economizing and purifying gas.*" July 18, 1870.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

340.—HEINRICH WITTHÖFT, of Copenhagen, in the kingdom of Denmark, for "*Improvements in gas-burners.*" Feb. 5, 1870.

436.—JOHN WEEMS and WILLIAM WEEMS, of Johnstone, in the co. of Renfrew, N.B., engineers, for "*Improvements in the manufacture or production of metallic pipes and sheets, and in making joints therefor.*" Feb. 15, 1870.

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LESMAHAGOW
CANNEL COAL.

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OFFICE:
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TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.
FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

WANTED, a situation as a Working FOREMAN. Has had many years experience in the erection of Gas-Works, main and service laying, &c. Lately returned from South America. Can produce testimonials and references as to character and ability.

Address G. ELLISON, 57, Napier Street, Shepherdess Walk, City Road, LONDON, N.

TO MAIN-LAYERS.

WANTED, several Men, for Belgium and Colombo.

Apply by letter only, with references, and state wages, to GEO. BOWER. St. Neots, HUNTS.

TO FOREMEN GAS-FITTERS.

THE Sheffield United Gaslight Company is in want of a thoroughly competent Man as FOREMAN of GAS-FITTERS. He must be capable of arranging for the lighting of public buildings, places of worship, mansions, and large works. Also of superintending the workmen in the execution of the work.

Apply in own handwriting, with references, stating age, wages required, and where last employed, to Mr. T. ROBERTS, the Manager, Shude Hill, SHEFFIELD.

TAR AND TAR-WORKS TO BE LET.

TO BE LET by Tender, for One, Three, or Five years, from the 1st of November next, the TAR-WORKS situate in Farington, near Preston, together with Tar produced at the various works belonging to the Preston Gas Company.

Tenders, endorsed "Tender for Tar, &c.," must be delivered to the undersigned, on or before Sept. 3 next.

For further particulars, apply to HENRY GREEN, Engineer.

T. EVANS & SONS, Retort-Setters and GAS-OVEN BUILDERS, having done the work at various Gas-Works in England and Wales for many years, can be well recommended. Testimonials and references on application.

Communications to be addressed to the Gas-Works, Cannock, near STAFFORD.

EAST BARNET GAS AND WATER COMPANY.

(Incorporated by Act of Parliament.)

OFFICES—ALBERT ROAD AND LYTTON ROAD, EAST BARNET, HERTS.

NOTICE is hereby given, that the ANNUAL ORDINARY MEETING of the PROPRIETORS of the Company will be held at the Board Room, on the Works, East Barnet, on FRIDAY, the 26th day of August, 1870, at Four o'clock.

By order,

Aug. 10, 1870. WM. C. HUMPHRYS, Secretary.

Business—To receive the Directors Report and Statement; declare a Dividend; elect two Directors; elect two Auditors, and for general business.

The Transfer Books will be closed from the 13th to the 27th inst. inclusive.

Trains leave King's Cross at 3.5 and 3.23 p.m.

OLD GOOLE GAS-WORKS.

TO BE SOLD BY AUCTION, by Mr. NATHANIEL EASTON, at the Lowther Hotel, in Goole, West Yorkshire, on WEDNESDAY, August 17, 1870, at Three p.m. (unless sold privately in the meantime), the GAS-WORKS at Old Goole, with the Manager's house, necessary outbuildings, and large garden. These works have been erected within the last few years, regardless of expense, in a substantial and workmanlike manner, in a very thriving and increasing populous locality.

To view, apply to Mr. JAMES YOUNG, Builder, near the station, GOOLE, or to the GAS MANAGER on the premises; and for further particulars, to the AUCTIONEER, 9, Bowlalley Lane, HULL, or to BURLAND, SON, AND PETCH, Solicitors.

South Cave, July 22, 1870.

ALFRED LASS,

ACCOUNTANT.

28, NORTH STREET, WANDSWORTH, S.W.

Mr. Alfred Lass having had considerable experience in arranging, making up, balancing and auditing gas accounts, begs to inform the Directors of Gas Companies that he may be consulted on all matters relating thereto.

Balance-sheets prepared, Accounts audited, Consultations, Agencies, &c.

W. J. SIMMONDS,

Retort and Boiler Setter and Contractor for Gas-Works in general,

7B, SOUTH STREET, NEW NORTH ROAD,

ISLINGTON, LONDON, N.

Upwards of 16 years Retort Setter to the Chartered Gas Company, Brick Lane and Curtain Road Stations.

Materials supplied on reasonable terms if required, or labour only.

No connexion with any other Retort Setter.

N.B.—Orders to be addressed as above.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET EDINBURGH.

Established 1840.

JAMES NEWTON & SONS,

(Established 1820,)

FIRE-BRICK AND TILE MERCHANTS,

Wholesale and for Exportation,

FALCON DOCK, 78 AND 79, BANKSIDE,

SOUTHWARK, LONDON, S.E.,

DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for

GAS AND WATER WORKS.

Established 1827. **Established 1827.**

WILLIAM & BENJAMIN COWAN,

WET & DRY GAS-METER MANUFACTURERS, BRASSFOUNDERS, &c.

STATION-METERS with PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, TEST GASHOLDERS, GAUGES, &c.

BUCCLEUCH STREET WORKS, EDINBURGH.

Sole Manufacturers of ESSON'S PATENT COMPENSATING GAS-METER,

AND OF

COWAN'S PATENT SIDE-VALVE GAS-METER,

All of which may be had with

NEWBIGGING and HINDLE'S "PATENT AIR-TIGHT INDEX-BOX,"

Of which W. & B. C. are the Sole Manufacturers.

W. & B. COWAN'S DRY GAS-METERS, in CAST-IRON CASES,

Possess a simplicity of construction and facility for repair greater than any yet produced, while the excellence of the material and workmanship, and accuracy of registration, cannot be surpassed. The superiority of their Dry Meters in Tin Cases is also well known, having stood the test of years.

PRICE LISTS ON APPLICATION.

WILLIAM INGHAM AND SONS,

WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

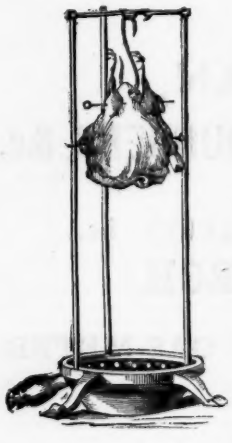
GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large Stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all Sizes kept in London at Mr. ALFRED WILLIAMS, Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

S. LEONI, ADAMAS WORKS, ST. PAUL STREET, NEW NORTH ROAD, LONDON, N.

One joint, one dish of potatoes roasted, and two pies baked in one hour, at the expense of one pennyworth of gas.



A joint of 6 lbs. roasted in 1 hour—consumption of gas 20 feet—cost one penny (at 4s. per 1000); 10 lbs., 1½ hour; 15 lbs., 2 hours.

Four quartern loaves of bread baked in one hour.

£5 5s. complete,
without flue.

FIRST-CLASS PRIZE MEDALS OF INTERNATIONAL EXHIBITIONS OF 1862 & 1867.
& CORNWALL ROYAL POLYTECHNIC INSTITUTION, 1869.

Economizer. Scale 1-10th of full size.

Economizer. Scale 1-10th of full size.

Portable Atmospheric Gas Heating Stove.

S. Leoni's Catalogue

LEONI'S PATENT STANDARD GAS BURNER.
One Shilling each. Triangles for Globes 6d. each.

LEONI'S PATENT ATMOSPHERIC GAS COOKING STOVES,
(Broiling and Roasting by Reflection only), from 15*s.* each.

LEONI'S PATENT ATMOSPHERIC GAS HEATING STOVES,
For Halls, Conservatories, Counting Houses, Rooms, Churches, &c. (most economical, no flue required), from £1 16*s.* each.

Leoni's Patent Atmospheric Open Gas Fires,
(Cheerful, brilliant, and most effective) with asbestos or clinkers), from £1 1*s.* each.

LEONI'S PATENT ATMOSPHERIC GAS APPARATUS.
With self-heating hot-water circulating boiler for green-houses and all buildings, (require no atttention, and are very economical).

LEONI'S PATENT ATMOSPHERIC GAS APPARATUS,
(No flue required) with copper circulating water boiler, and 5 ft. 6 in. bath, (36 gallons of water raised to a temperature of 100° F. in ½ hour with less than a pennyworth of Gas and without any smell), from £10 10*s.* complete.

LEONIS PATENT ATMOSPHERIC GAS ROASTING & ALSO BAKING APPARATUS.
(In 1 hour's time with less than 1 pennyworth of Gas 6 lbs. of meat are well roasted, or 16 lbs. of bread baked, also one joint roasted, one dish of potatoes roasted, and 2 pies baked, all together in one hour), from £5 5*s.* each complete.

Leoni's Patent Gas Baking, & also Roasting Ovens,
Portable for stationary, or families, restaurants, hotels, clubs, hospitals, and establishments of the largest kind.

Leoni's Patent Atmospheric GAS RANGES,
Complete. Portable or stationary, for families, hotels, &c.

IMPROVED PATENT ADAMAS GAS BURNERS,
(Approved and highly commended by the official Gas Referees, *Vide* "Report," obtained Prize Medals in 1862 and 1867), from 1*d.* each.

LEONI'S IMPROVED PATENT ADAMAS TAPS
For Beer, Wine, Acid, &c., never corrode or leak, turn always easy and smooth, and are constantly clean and sweet, from 1*s.* 3*d.* each.

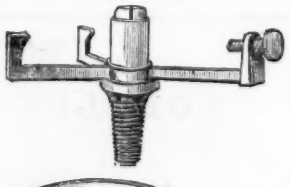
Chops and steaks, or two fowls, or a joint roasted on gridiron, and, at the same time, soles, &c., fried on top of the reflector.

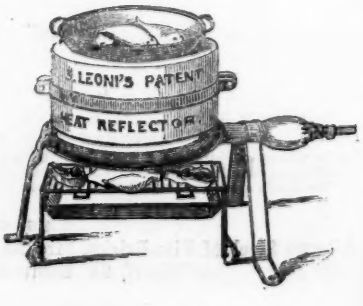
Gas consumers, once aware of the advantages of cooking by Gas, will be glad to meet with efficient apparatus, and Gas Companies have every interest to make such apparatus known.

AGENTS WANTED IN EVERY TOWN.

LIBERAL TERMS.

PATENT STANDARD BURNER.
Scale ½ size.





1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.

This Paint having been in general use over eight years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

GEORGE NEWTON,

UNION STREET WEST, OLDHAM,

MANUFACTURER OF

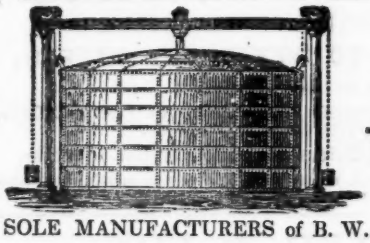
IMPROVED WET & DRY CONSUMERS GAS-METERS,

GAS STATION-METERS,

With all the Joints planed,

GOVERNORS, GAUGES, INDICATORS, EXHAUST GOVERNORS, &c.

TERMS, &c., ON APPLICATION.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

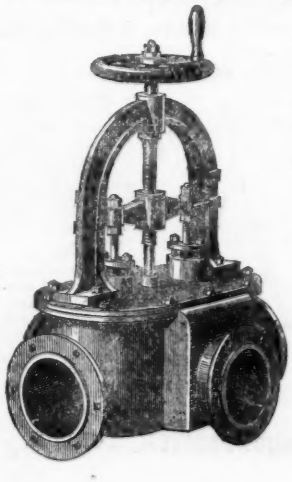
LONDON OFFICES—57, GRACECHURCH STREET, CITY.

*** *Please address letters to Huddersfield.*

REFERENCES TO NEARLY 300 GAS-WORK

CATHELS & TERRACE'S

PATENT FOUR-WAY DISC GAS-VALVE



(Being a simplification and improvement of Cathels's well-known Valve) is the best Valve for Gas-Works. It is specially applicable as a by-pass to Condenser, Exhauster, Scrubber, Station-Meter, &c., as, having no springs, ground faces, or other delicate complications to be affected by crude gas, it NEVER SETS FAST. When applied to Purifiers, the utmost facility of change is afforded; the direction of the flow of the gas is seen at a glance, and no unpurified gas can pass into the holders at each change, as happens with Centre-Valves. In either application ONE VALVE SERVES AS THREE OTHER VALVES. The opening and closing are now effected by one movement, and the ports being all on the same level, enables the connexions to be simple lines of straight piping. The closing of one gas-way opens another, preventing the possibility of accidentally stopping back the gas. The Valve has been in general use for upwards of five years, with the most satisfactory results, and is so simple and strong that it may be considered indestructible.

Illustrated Circular, Prices, &c., on application to the Makers,

Messrs. GUEST & CHRIMES,

FOUNDRY AND GENERAL BRASS-WORKS,

ROTHERHAM.

CANNEL COAL.—The West Yorkshire Iron and Coal Company, Limited, beg to draw the attention of Gas Companies to their Cannel, of which the following is the analysis made by W. Huggon, Esq., F.C.S.:

Yield of gas per ton	10,296 cubic feet.
Illuminating power rather over	21 sperm candles.
Yield of coke per ton . . .	12 cwt.

The actual working, as reported by one of the largest gas companies in Yorkshire, gives results still more favourable, viz.—

Yield of gas	10,416 cubic feet.
Illuminating power	21·89 sperm candles.
Coke	The same.

We add from the same source the capabilities of the common gas coal—

Yield of gas	10,080 cubic feet.
Illuminating power	14·41 sperm candles.
Yield of coke	13 cwt.

COLLIERIES—WEST ARDSLEY, near LEEDS.

For further particulars, address to the Office of the Company, 15, York Place, LEEDS.

POPE & PEARSON'S GAS COAL.—We have now the authority of several of the most eminent Gas Engineers of London in stating that our Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles.*

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, West Riding and Silkstone Collieries, near LEEDS.

OLD WEMYSS CANNEL COAL.—Yield of gas per ton, 12,896 cubic feet; illuminating power, 31·75 standard candles. Port of shipment, Wemyss.

Analysis and price on application to Mr. WM. CAREY, Manager, Wemyss Colliery, Kirkcaldy, FIFE.

CANNEL COAL.

MESSRS. GRIFFITHS BROTHERS,
COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their Cannel for gas-making purposes.

This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

Waggons supplied for delivery by railway to any part of England or Wales.

For particulars, prices, and rates of freight, apply to GRIFFITHS BROTHERS, Coppa Colliery, Mold, FLINTSHIRE.

THE
HUCKNALL COLLIERY COMPANY
Can offer a CANNEL COAL yielding a large quantity of Gas of superior quality.

Prices and information on application to the HUCKNALL COLLIERY COMPANY, Hucknall Torkard Collieries, near NOTTINGHAM.

THOMAS EDINGTON & SONS,
PHŒNIX IRON-WORKS,
GLASGOW,
Manufacturers of all kinds of
GAS AND WATER PIPES,
Branches, Bends, Water-Traps, Tank-Plates, Valves, and general Castings. Also
RAILWAY CHAIRS & SLEEPERS,
AND
GRIFFIN'S PATENT PERMANENT WAY.
London Office, 63, Old Broad Street.

WALTER MABON & CO.,
Engineers,
ARDWICK IRON-WORKS,
FAIRFIELD STREET, MANCHESTER,
MANUFACTURERS OF
IRON TANKS, GASHOLDERS,
GAS APPARATUS,
PIPES, VALVES, IRON ROOFS,
WROUGHT AND CAST IRON GIRDERS.
DESIGNS, SPECIFICATIONS, & ESTIMATES FURNISHED.

FIRE-CLAY GAS-RETORTS, &c., CANNEL AND STEAM COALS.

WILLIAM FRASER, Inverkeithing (owner of the Works at which Fire-Clay Retorts were first made), having greatly enlarged his Works, can supply RETORTS and other FIRE-CLAY GOODS to any extent.

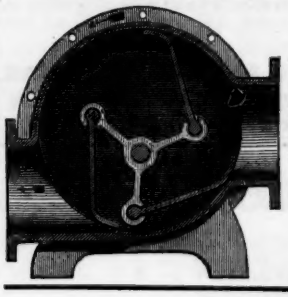
References can be given to managers of above a hundred Gas-Works whom he supplies.

WILLIAM FRASER ships COWDENBEATH PARROT COALS at Charlestown and Burntisland at 11s. per ton; and HALBEATH STEAM COALS, on Navy List, at 7s. per ton.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for good quality of Fire-Bricks.
WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

J. T. B. PORTER & CO.,
GAS ENGINEERS,
MANUFACTURERS AND CONTRACTORS FOR GAS-WORKS
Of any extent at Home and Abroad,
GOWTS BRIDGE WORKS, LINCOLN,
AND
JOHN STREET, ADELPHI, LONDON, W.C.

WALTER FORD,
159, GRAY'S INN ROAD, LONDON,
MANUFACTURER OF
WET & DRY GAS-METERS, STATION-METERS, GOVERNORS, &c.
SOLE MANUFACTURER OF
PADDON'S PATENT STREET-LAMP REGULATORS,
For ensuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.



CHARLES HORSLEY'S
PATENT
GAS EXHAUSTER.
(From 250 Feet upwards per Hour.)
Also,
ROTARY TAR AND OIL PUMPS.
For particulars and prices apply to the Patentee,
22, Wharf Road, City Road, London, N.

ROBERT DEMPSTER,
Gas Engineer and Contractor, Rose Mount Foundry, Elland, near Halifax.

R. D. recommends his Fire-Brick Retorts to Engineers and Managers of Gas Companies; they last from 10 to 12 years.

Iron and Fire-Clay Retorts.
Annular and Pipe Condensers.
Scrubbers and Purifiers, all sizes.
Steam-Engines and Exhausters.
Hydraulic Centre-Valves.
Station-eMters and Governors.
Photometers & Pressure-Gauges.
Lamp-Posts and Brackets.
Cast-Iron Mains and Syphons.
Wrought-Iron Tubes, Water Tanks.
Wrought-Iron & Cast-Iron Roofs.
Gasholders, Single-Lift or Telescopic.
Gas Castings of every description.
Retort Setters and Fitters sent to all parts of the country.
Wood Sieves for Purifiers.

Plans and Specifications prepared.

WILLEY & FORD,
GAS ENGINEERING WORKS, EXETER,
CONTRACTORS FOR THE ERECTION OF GAS-WORKS,
MANUFACTURERS OF IMPROVED WET & DRY METERS;
Also, EVERY DESCRIPTION OF GAS APPARATUS,
Comprising GASHOLDERS, STATION-METERS, GOVERNORS, CONDENSERS, PURIFIERS, RETORTS, SLIDE-VALVES, and every article appertaining to Gas-Works.
Gas Companies advised on Improvements, Extensions, and Alteration of Works.
*** The very best material and workmanship guaranteed, and at prices bearing a favourable comparison with any House in the Kingdom.

SAMUEL CUTLER & SON,
CONTRACTING GAS ENGINEERS, &c.
MANUFACTURERS OF GASHOLDERS, TANKS, PURIFIERS,
AND ALL DESCRIPTIONS OF GAS-MAKING APPARATUS.
Iron Roofs, and General Iron Work. Mains Supplied and Laid.
S. C. & SON supply every requirement for a Gas-Work, and keep in stock Retort-Lids, Cotters, Barrows, Scoops, Bolts and Nuts, &c., &c.
PROVIDENCE IRON-WORKS, MILLWALL, LONDON, E.

TO GAS COMPANIES AND THE TRADE.
J. DEFRIES & SONS,
MANUFACTURERS OF
CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN
LIGHTS, AND THE PATENT CRYSTAL ILLUMINATION;
Vestibules, Iron Barrel, Composition Tubing, Dry & Wet Meters, & Gas-Fittings
OF EVERY DESCRIPTION.
WORKS: LONDON, BIRMINGHAM, & PARIS.
REGISTERED DESIGNS.

Special Designs prepared in perfect accordance with architectural arrangements. Estimates furnished for the Lighting and Fitting up of Theatres, Music Halls, and Public or Private Buildings with Gas.

Gas Moons of the newest designs.

The Patent Gas-Regulator and Purifier reduced to 6s. 6d. per Doz.

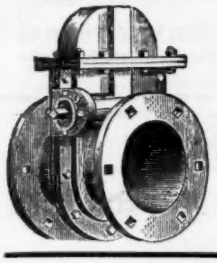
Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1870, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.
ESTABLISHED 1803.

REDUCED PRICES
OF
B. DONKIN & CO.'S
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS,

TRADE MARK.

From 2 inches to 18 inches, price 9s. 6d. to 12s. per inch diameter.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.

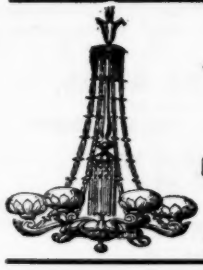
VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO,
SCREW WATER-VALVES WITH GUN-METAL FACES.

B. DONKIN & CO.,
GENERAL ENGINEERS AND IRONFOUNDERS,
MAKERS OF STEAM-ENGINES,
BERMONDSEY, LONDON, S.E.

A. C. FRASER, F.S.A.,
GAS AND CONSULTING ENGINEER,
COLCHESTER, ESSEX,
INVENTOR & PATENTEE of CAST-IRON & FIRE-CLAY RIBBED RETORTS.

Mr. Fraser having had more than Twenty years experience in the Construction, Alteration, and Management of GAS and WATER WORKS, will be happy to furnish information on all matters appertaining thereto.

Plans, Specifications, and Estimates prepared.



F. & C. OSLER,
45, OXFORD STREET, LONDON, W.
MANUFACTORY AND SHOW-ROOMS:
BROAD STREET, BIRMINGHAM.
ESTABLISHED 1807.
MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS,
WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.
TABLE GLASS OF ALL KINDS.
CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

JAMES MILNE & SON,
GAS ENGINEERS,
Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
EDINBURGH, AND
2, KING EDWARD STREET,
NEWGATE STREET, LONDON.

Station-Meters, Governors, Consumers Meters, Gas Lustres, Chandeliers, Brackets, &c., and every description of Gas-Fittings and Gas Apparatus.

GEORGE ANDERSON,
GAS AND CONSULTING ENGINEER,
19, NORTHUMBERLAND STREET, STRAND, W.C.

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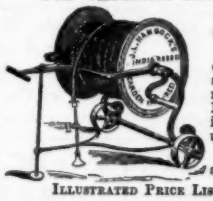

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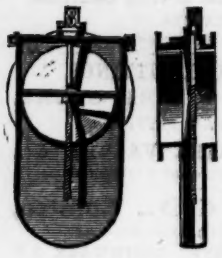

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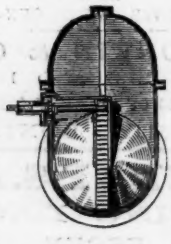

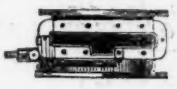

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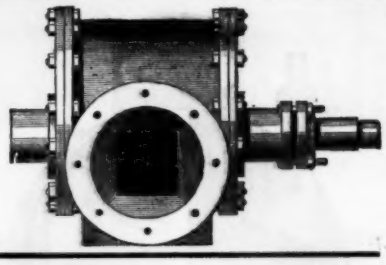

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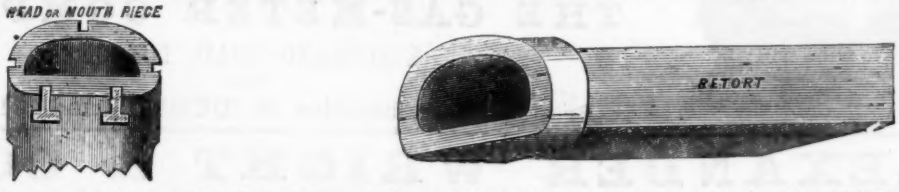

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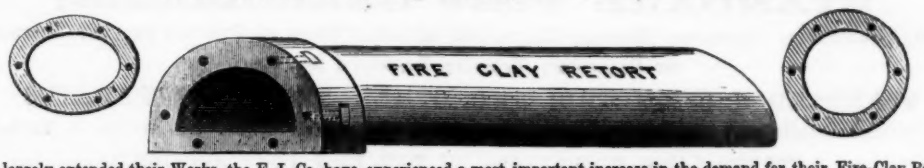

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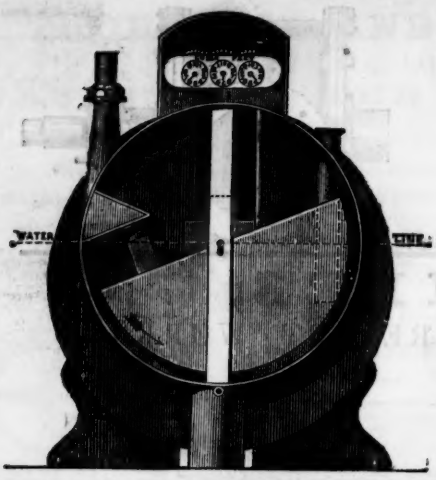

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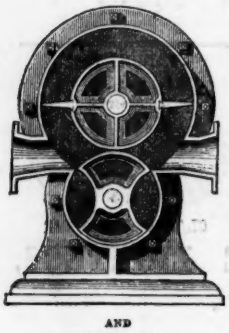

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